

# THE

Theoriques of the seuen Planets, shewing  
all their diuerse motions, and all other Accidents, cal-  
led Passions, thereunto belonging. Now more plainly set forth in  
our mother tongue by M. *Blundeuile*, than euer they haue been heretofore in any  
other tongue whatsoeuer, and that with such pleasant demonstratiue figures, as eue-  
ry man that hath any skill in Arithmeticke, may easily vnderstand the same.

A Booke most necessarie for all Gentlemen that are desirous to be skil-  
full in Astronomie, and for all Pilots and Sea-men, or any others  
that loue to serue the Prince on the Sea, or by the  
Sea to trauell into forraine Countries.

Whereunto is added by the said Master  
*Blundeuile*, a breefe Extract by him made, of *Magi-  
nus* his Theoriques, for the better vnderstanding of the  
Prutenicall Tables, to calculate thereby the diuerse mo-  
tions of the seuen Planets.

There is also hereto added, The making, description,  
and vse, of two most ingenious and necessarie Instruments for  
*Sea-men*, to find out thereby the latitude of any Place vpon the Sea  
or Land, in the darkeſt night that is, without the helpe of Sunne, Moone, or Starre.  
First inuented by M. Doctor Gilbert, a most excellent Philosopher, and  
one of the ordinarie Physicians to her Maieſtie: and now here  
plainely set downe in our mother tongue by  
Master *Blundeuile*.

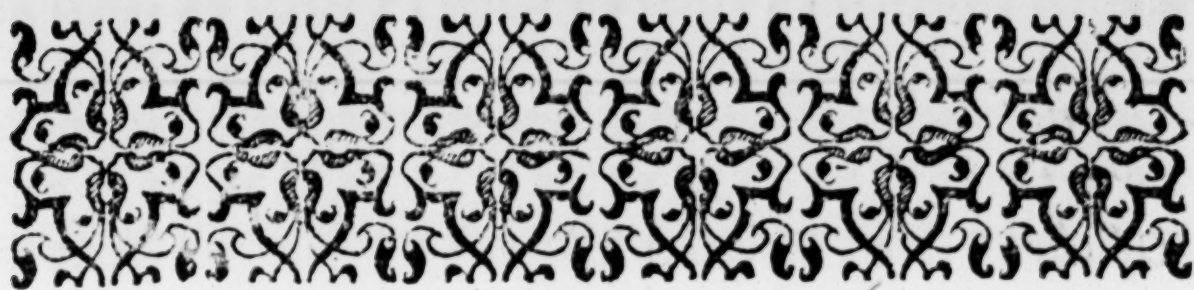


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## ☞ To the Reader.



Being aduertised by diuers of my good friends, how fauorably it hath pleased the Gentlemen, both of the Court and Country, and specially the Gentlemen of the Innes of Court, to accept of my poore Pamphlets, entituled *Blundeuiles Exercises*; yea, and that many haue earnestly studied the same, because they plainly teach the first Principles, as well of Geographie as of Astronomie: I thought I could not shew my selfe any way more thankfull vnto them, than by setting forth the Theoriques of the Planets, vvhich I haue collected, partly out of *Ptolomey*, and partly out of *Purbachius*, and of his Commentator *Reinholdus*, also out of *Copernicus*, but most out of *Meſtelyn*, whom I haue cheefely followed, because his method and order of writing greatly contenteth my humor. I haue also in many things followed *Maginus*, a later vvriter, vvhoe came not vnto my hands, before that I had almost ended the first part of my booke, neither should I haue had him at all, if my good friend M. Doctor *Browne*, one of the ordinarie Physicians to her Maiestie, had not gotten him for me, with which



*To the Reader.*

good Doctor I haue had in times past at Norwiche many learned conferences, and haue receiued at his hands many good documents, whom I take to be so vniuerfally learned in all manner of good and liberall Sciences, as any other that I know in these daies: and besides his great learning, I know him to be very wise and honest, which two vertues I vvish to raigne in all learned men, because they be the greatest ornaments that belong to learning. I haue deuided this my booke into two parts, whereof the first part treateth of the diuers motions of the Planets; and the second part, of their Passions; and that so plainly, and vvith such facilitie, as I hope that euery man of a meane capacitie may vnderstand the same. For I thought good to collect out of the foresaid Authors no more but that vvhich onely was meet and fit for that purpose, praying all those that be learned, hereafter to adde to this my booke any necessarie thing, that I through age and vvant of cleare sight, haue negligently omitted. And so I leaue to trouble you, praying you to take this my labour in good part, so shall I haue iust cause to thinke the same well bestow-  
ed. *Vale.*



# THE THEORIQVES

of the seuen Planets, shewing all their  
diuerse motions, and all other accidents  
(called passions) thereunto belonging.



With euery art hath his proper tearmes, without the knowledge whereof, no art is easily learned : Minding therefore here to treat of the Theoriques of the Planets, I thinke it best first to set down all the tearmes together with the true significations thereof : which tearmes, though they bee manifold, yet they may be all reduced into seuen. For whatsoeuer tearme it bee, it signifieth either a point, a centre, a line, a circle, a semicircle, a portion of a circle otherwise called an arche, or an orbe, called in Latine *Orbis*, which is as much to say, as a round hoope or sphere, hauing breadth and thickenesse, and sometime it is taken for a circle. And you see here, that I make a difference betwixt a point and a centre ; for though euery centre is a point, yet euery point is not a centre. Again, I make a difference betwixt a circle and an orbe ; for though they bee like, in that they both haue round shape, yet they differ, in that the orbe hath both breadth and thickenesse, and the circle hath neither. But before I

B

define



define the termes belonging to the Theorique of anie Planet, I thinke it best, according to the method and order vsed by *Michaell Mestlyn*, to set downe foure principall intentions, meet to bee vsed in describing the Theorique of euerie Planet: of which foure intentions,

1. The first is to shew of how many particular orbes euery Theorique consisteth.

2. The second is to shew towards what part such orbes are moued, and in what time they make their reuolutions, and also vpon what centres or poles they make their regular mouings.

3. The third intention, is plainely to describe all such points, lines, arches, semicircles, and such like things as are needfull to be knowne for the calculating of the mouings of any Planet.

4. The fourth intention, is to shew how much latitude euery Planet (hauing latitude) hath: for euery Planet hath latitude, more or lesse, the Sunne onely excepted, which hath no latitude, because he neuer departeth from the Eclipticke line, with whose Theorique I mind here first to deale.

*Why deale you first with the Theorique of the Sun?*

**F**OR foure causes. First, because his Theorique is more easie than all the rest.

Secondly, as well for that he excelleth in dignitie all the other Planets, as also for that the mouing of all the other Planets dependeth vpon his mouing: which vnles it be known, none of the others can be thoroughly known.

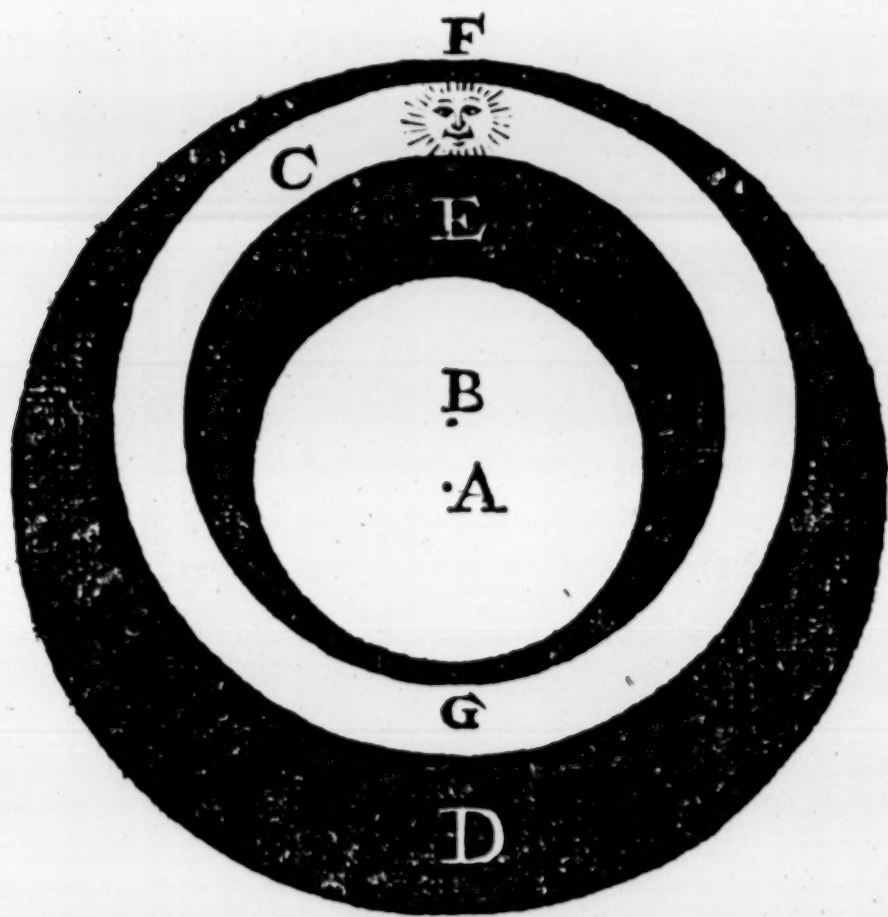
Thirdly, for that the mouings & reuolutions of all the rest of the Planets are counted by his yearly reuolutions.

Fourthly,

Fourthly, by the authoritie of *Ptolomey*, and other auncient writers, which in treating of the Theoriques, doe first begin with the Theorique of the Sunne.

**N**OW here followeth the first Intention, shewing by certain figures, of how many orbes the Theorique of the Sunne consisteth, that is, of three orbes, hereafter described, & are contained in this figure next following.

*The first figure belonging to the Theorique of the Sunne, shewing his three orbes, and their centres, and also the two points called Auges, hereafter defined.*



**T**Hough the Theorique of the Sun consisteth but of three orbes, yet you see here, that in this figure there be four orbes or circles, that is, two black, and two white: whereof the vpper blacke circle, marked with the letter **B ij** **D**, is



D is called the vpper deferent of the Auges; and the lower blacke circle, marked with the letter E. is called the inferior or lower deferent of the Auges; and the largest and greatest white circle, marked with the letter C. is called the Excentricke or deferent of the Sunne, hauing the bodie of the Sunne fixed therein: and in the middle white roundle are set downe two prickes or centres, whereof that which is marked with the letter A. is the centre of the world; and the other next aboue that, marked with the letter B. is the centre of the deferent of the Sun, otherwise called the Excentricke; and the point which is in the vpper lymbe of the deferent of the Sun, marked with the letter F. is called in the Arabike tongue *Aux*, in Greeke *Apogæon*, in Latine *Absis summa*, that is to say, the highest point, which I meane to call in our tongue in the singular number, Auge, and in the plurall number, Auges: the opposite point whereof, marked with the letter G. is called in Greeke *Perigæon*, and in Latine *Absis ima*, that is to say, the lowest Auge. It is also called *Oppositum Augis*, that is, the point opposite to the Auge: so as by this figure you may perceiue, that the point Auge is a point in the deferent of the Sunne, farthest distant from the centre of the earth, and therefore is called of some *Longior longitudo*, that is, the farthest longitude, marked in the former figure with the letter F; and the opposite point to that, is called *Propior longitudo*, that is, the nigher longitude, because it is nigher to the centre of the earth, and is marked in the said figure with the letter G. There be also in the said deferent, two other points of the meane longitude, whereof we shall speake hereafter. You see also, that the pricke, marked with the letter A. is the centre of the world; & that the other prick,

mar-

marked with the letter B. is the centre of the deferent of the Sunne, which, because it is out of the centre of the world, and distant from the same, it is called the centre of the excentricke: and the distance betwixt these two centres, is called in Latine *excentricitas*; and I likewise from henceforth will call such distance the excentricitie.

*Now describe the three foresaid circles or orbes, and shew whereto they serue?*

THE first, called the orbe excentricke, which in the former figure is made white, and marked with the letter C. is that which carieth the body of the Sun, and therefore is called in Latine *Deferens Solis*, and I will also call it the deferent of the Sun: in the vtermost circumference whereof, are set the foresaid two Auges, the one right opposite to the other, marked with the letters F. G. as before is said. The other two blacke orbes, marked with the letters D. E. are those which carrie the Auges, & therefore are called the deferents of the Auges, which be two seuerall orbes; and yet to auoid *Vacuum*, doe enclose one another in such sort, as the slenderest or narrowest part of the vppermost orbe, marked with the letter D. doth joine close to the thickest or fullest part of the nether orbe, marked with the letter E. and the slenderest or narrowest part of the nether orbe, joyneth close to the thickest or fullest part of the vpper orbe: and these two orbes do contain within them the orbe excentrique, or deferent of the Sunne, and also doe make the whole sphere of the Sunne to be concentrique, that is to say, to haue all one centre with the centre of the world: and yet in certaine respects, these two orbes are also excentrique,



trique, that is to say, hauing a centre distant from the centre of the world: for the concaue superficies of the vppermost blacke orbe, and the convexe superficies of the nethermost blacke orbe, beeing seuerally taken, haue the selfe same centre which the deferent of the Sunne hath, which is the centre excentricke, marked with the letter B. All which things the former figure doth plainly shew.

*Wherefore was the deferent of the Sunne supposed to be excentricke?*

**F**OR three principall causes. First, for that the moouing of the Sunne is vnequall, now slower, now swifter.

Secondly, for that the bodie of the Sunne, by his vnequall distance from the earth, seemeth to our sight sometime greater, and sometime lesser, the grossenesse or thinnesse of the aire being no cause thereof.

Thirdly, for that the Sunne being in this or that part of the Zodiacke, the eclipse of the Moon continueth longer or shorter time, so as she abideth vnder the shadow of the earth more one time than another. All which things are salued by supposing an excentricke.

*Is the deferent of the Sunne, and the circle excentricke, one selfe thing?*

**N**O, for though they haue both one selfe centre, called the centre of the excentricke, yet the circle excentricke is the circumference of a circle imagined to be in the middle of the deferent, & is described by the centre of the Sunnes body, deuiding the deferent into two equall

equal parts or hemispheres, as you may see in the second figure next following.

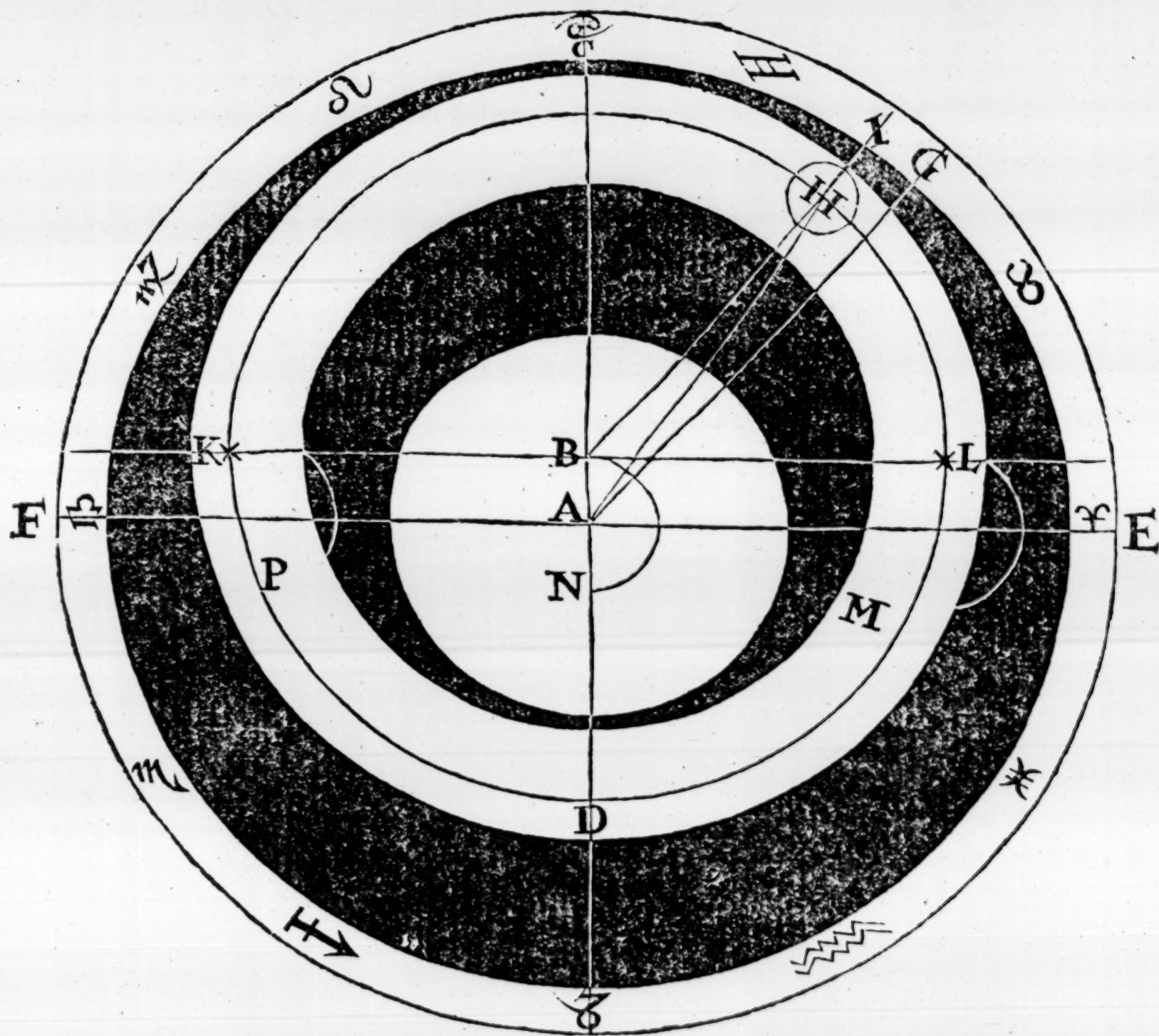
*The second Intention sheweth what moouing these orbes and circles before mentioned haue, and vpon what poles and axletrees they are turned about.*

**B**Efore I come to the declaration therof, it shall be necessary to set downe one other figure, containing the most part of such lines, points, centres, circles, semicircles, and arches, as doe belong to the Theorique of the Sunne, and to shew what they signifie. I say here for the most part, because both these & all the rest shall be more fully declared, when wee come to the third Intention, whose office is to shew all such things at the full.

*g The*



¶ The second figure belonging to the Theorique of the Sunne.



In this figure, the outermost white orbe signifieth the Zodiake, in which are described the characters of the twelve signes. And the next white orbe within that, is the deferent of the Sunne, in which is a little circle, representing the

the bodie of the Sunne, whose centre is marked with the letter H. and the two blacke orbes are the two deferents of the Auges of the Sunne before described; and in the middle white rundle are set down the two centres before described, that is, the centre of the world, marked with the letter A. and the centre of the deferent of the Sunne marked with the letter B. Moreover, in this figure are drawne certaine right lines, whereof the long perpendicular line passing through both the foresaid centres, marked with the letters C. D. is called the line of the Auges, and the ouerthwart line passing through the centre of the world to the Zodiake, marked with the letters E. F. signifieth the Ax e tree of the Zodiake, whose outermost ends are the poles of the eclipticke. Then there is another ouerthwart right line paralell to the foresaid line E. F. which passing through the centre excentrique extendeth vnto the deferent of the Sunne, from the one side to the other side thereof, whose outermost ends are the poles of the said deferent, marked with the letters K. L. Besides these three lines, there are three other lines, whereof that which passeth from the centre of the world to the Zodiake, marked with the letters A. G. is called the line of the Sunnes meane mouing. Then there is another line paralell to that, which passeth from the centre of the deferent to the centre or middest of the Suns bodie, marked with the letters B. H. And the third line passing from the centre of the world through the midst of the Sunnes bodie, even to the Zodiake, is called the line of the Sunnes true mouing, marked with the letters A. H. I. There are also in this figure certaine portions of circles called arches, which haue their proper significations, as the arch of the Zodiake, contained betwixt the

C the



the first point of Aries, and the line of the Auges, marked with the letters E. C. is called the Auge of the Sun in his second signification, and the arch containd betwixt E. and G. is called the meane mouing of the Sun, and the arch contained betwixt E. and I. is called the true mouing of the Sunne, and the arch contained betwixt G. and I. is called the equacion of the Sunne, and the arch contained betwixt the line of ~~the~~ meane mouing of the Sunne, and the line of the Auges marked with the letters C. G. is called of some *Argumentum*, and of some *Anomalia*, that is, the inequality of the Sunnes mouing. All which arches shall be more fully shewed and declared in the third figure next following.

There bee also in this figure three little semicircles, whereof the two, marked with the letters K. P. and L. M. doe signifie those circles which the poles of the excentrique doe describe by the mouing of the two deferents of the Auges; and the third semicircle marked with the letters B. N. signifieth that circle which the centre of the excentrique describeth by the mouing of the said deferents of the Auges about the centre of the world, the semidiameters of all which circles are equall.

*Doth the Theorique of the Sunne onely consist of the three orbes aboue mentioned, that is, of the deferent of the Sunne, and of the two deferents of the Auges?*

**T**Hough the auncient Astronomers doe appoint no more but those three, yet *Copernicus* hauing found by many obseruations made by himselfe and others since their time, that the Auges of the Sunne doe moue vnequally, and that the excentricitie doth alter: hee therefore

fore to salve that apparence, dooth adde another orbe called the excentor of the excentrique; which indeed are two shaddowed orbes, enclosing one another like as the two blacke orbes doe, the shape whereof you may see plainly expressed in the sphere of Mercurie, hereafter following.

*Now shew how the foresaid three orbes are mooued, and first how the excentrique of the Sunne is moued, and in what time he maketh his revolution?*

**T**He excentrique or deferent of the Sunne is regularly moued vpon his owne centre, according to the succession of the signes right vnder the eclipticke, and maketh his revolution in the space of one whole yeare, that is in 365 dayes, and almost fixe houres, and by the revolution of this orbe is described or limited the Suns yeare. And you haue to note, that the tables of *Alphon-*  
*sus* and the Prutenicall tables do in a manner agree, touching the daily moouing of this orbe, which is  $\frac{i}{9} \cdot \frac{ii}{8} \cdot \frac{iii}{19} \cdot \frac{iiii}{37} \cdot \frac{v}{24}$ . so as his yearely revolution containeth 365 dayes, 5. houres.  $\frac{i}{49} \cdot \frac{ii}{15} \cdot \frac{iii}{46}$ . sauing that the tables of *Alphon-*  
*sus* doe faile in the daily mouing,  $\frac{v}{13}$ . and thereby in the yearely revolution doe exceed the Prutenicall tables by  $\frac{iii}{13}$ . and so much is the equall tropicall yeare, according to *Copernicus*, counting the same from the very equinoctiall point: but the daily moouing of the Sunne beeing counted from the first starre of the Rams horne, is  $\frac{i}{9} \cdot \frac{ii}{8} \cdot \frac{iii}{11} \cdot \frac{iiii}{22} \cdot \frac{v}{10}$ . so as his yearely revolution containeth 365 dayes, 6 houres,  $\frac{i}{9}$ . and  $\frac{ii}{39}$ . and this is called the syderall yeare.

The poles of this orbe doe equally obserue the poles



of the eclipticke, and therefore the centre of the Sunnes bodie doth neuer swarue from the eclipticke line.

*Why doth not this Orbe also cary the Sunne equally about the centre of the world?*

**B**Ecause that euery circular moouing that is equall, maketh in equall time in his circumference both equall arches and also equall angles, vpon the centre of equacion; which centre in this Theorique, is all one with the centre of the excentrique marked with B. though in other Planets the centre of equacion is a seuerall centre by it selfe. And this kind of mouing is only regular vpon one centre, and not vpon many or diuerse centres, as you may perceiue by the third figure next following: in which figure the Sun being in his excentrique, and turning about the centre B. is said to be equall, for whilst he descendeth from F. to H. on the left hand of the figure, he maketh the arch of his excentrique to be F.H. and the angle to be F. B. H. vpon his owne centre B. which is an obtuse or blunt angle: but vpon the centre A. he maketh a lesser angle, which is F. A. H. for that is a right angle; and so by this meanes the angle F. B. H. should be equall to the angle F. A. H. that is to say, the greater to the lesser, which is vnpossible. Wherefore the angles made vpon A. the centre of the world, are not equall to the angles made vpon the centre of the equall mouing, marked with B. and therefore the mouing of the Sunne about the centre of the world, appeareth to be vnequall, sometime slower and sometime swifter, according to the vnequal arches of the excentrique, subtending equal angles in the centre of the world.

*How*

*How are the deferents of the Auges moued?*

**T**hey are moued about the centre of the world, and vpon the poles of the Eclipticke, according to the succession of the signes, making by vertue of the eight sphere, one revolution together with the said sphere, according to *Alphonsus*, in 49000 yeares, and by this mouing they put forward the Auge of the excentrique by little and little into the next following degrees of the Eclipticke, and by reason of the incredible slownesse of these orbes in their mouing, the Astronomers doe not agree in the quantitie of their revolution. For *Ptolomey* thought them to be immouable, and the followers of *Alphonsus* thought their revolution to be vnequall, and to be made in 49000 yeares, as before. But *Copernicus* being holpen by the obseruations of many ages, doth shew that these orbes doe passe through the Zodiacke in 17108 Ægyptian yeares, and that they passe through the orbe of the fixed stars almost in 50718 Ægyptian yeares; and that the other orbe called the excentor of the excentor, which he himselfe addeth to the other orbs, doth make his revolution vpon his owne centre, which is the centre of a little circle, contrarie to the succession of the signes, in 3434 Ægyptian yeares: and by the mouing of this orbe, he sheweth that the true Auge of the Sun creepeth on vnequally, & that the excentricitie doth alter and change.

*The dimension or measure of the Sunnes sphere.*

**T**he greatest excentricitie of the Sunne, according to the demonstrations of *Copernicus*, containeth two  
C iij
degrees,



degrees,  $\frac{1}{10}$ . and  $\frac{11}{10}$ . such like parts or degrees I say, as the semidiameter B. F. of the excentrique containeth sixtie degrees. And the least excentricitie containeth but one such part,  $\frac{1}{55}$ . and  $\frac{11}{55}$ . And by the demonstrations of the said *Copernicus*, the foresaid semidiameter B. F. dooth containe 1142 semidiameters of the earth. And A. B. in his greatest excentricitie containeth almost 48 semidiameters of the earth. And the said A. B. in his least excentricitie containeth almost 37 semidiameters of the earth, so as when the excentricitie was greatest, and that the Sunne was in his Auge, according to the line A. F. set downe in the third next figure, hee was then distant from the centre of the earth 1190 semidiameters of the earth, which distance *Ptolomey* thought to be 1210 semidiameters of the earth. And when the Sun was in the point opposit to the Auge, he was then distant from the centre of the earth, according to the line A. G. set down in the said third figure, 1094 semidiameters of the earth. But when the excentricitie is least, as it is in this our age, then the Sunne being in his Auge, is distant from the centre of the earth 1179 semidiameters of the earth, but in these dayes the point opposit to the Auge, approacheth not so nigh to the earth, as it hath done in times past, for his distance now containeth 1105 semidiameters of the earth, which is further off than the former distance was, by eleuen semidiameters of the earth. And you haue to note, that one semidiameter of the earth containeth 3436 Italian myles, and  $\frac{8}{11}$ . of a myle.

*The third Intention, shewing what points, lines, and arches are necessarie to be knowne touching the Theorique of the Sunne.*

**T**Hough I haue heretofore partly described such things in the first and second figures, yet I mind once againe to declare the same againe according to *Mestlyn*, who describeth euery thing, and setteth downe a third figure, expressing the same in such order as followeth.

Seeing the mouing of the Sun, by reason of the orbe excentrique, is vnequall, and that the true mouing doth differ from the meane mouing, for that cause it is necessary to know what the point Auge and his opposit point is, and their moouing: Also which are the lines of the meane mouing and true moouing of the Sun, and what is the yearely inequalitye of such mouing, called of *Alphonsus, argumentum*, and what the meane mouing and true moouing of the Sunne is, and finally, what the Equacion is.

*What is the mouing of the point Auge, and of his opposite point?*

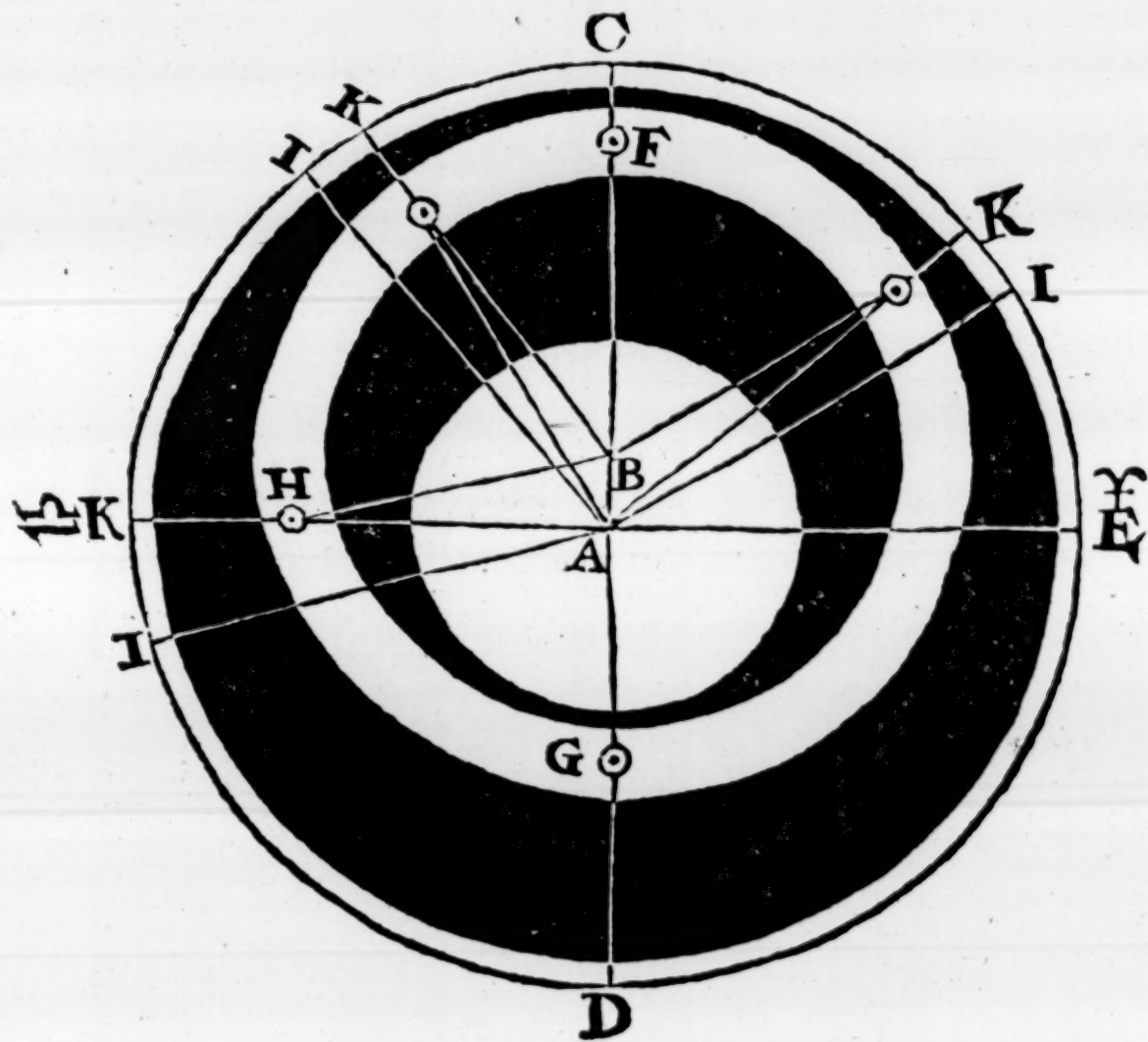
**I**T is an arch of the Eclipticke, contayned betwixt the beginning of Aries, and the line of the Auges, which arch is called of *Purbachius* and others the Auge of the Sunne, in his second signification: for Auge in the first signification, is only a point before described in both the former figures.

¶ The

2



¶ The third figure belonging to the Theorique of the Sunne.



¶ The circles of this figure are like in signification to the circles before set downe in the second figure, and in this figure betwixt the letter E. signifying here the beginning of Aries, and the letter C. signifying the point Auge, is contained the arch E. C. limiting the moouing of the point Auge, counting from the beginning of Aries: but *Ptolomey* found in his time, that the said point was in the first degree  $30^{\circ}$  of Gemini, which point in these dayes, according to *Copernicus* his calculation, is almost in the ninth degree of Cancer.

The

The maintainers of *Alphonſus* his tables haue ouer boldly, as well here as els where, ſwarued from *Ptolomey*, in affirming the Auge of the Sunne to haue been in his time contrarie to his owne obſeruations, in the 13 degree  $\frac{1}{2}$  of Gemini, ſo as in theſe dayes that point ought to be in the firſt degree of Cancer: to whom no credite in this matter is to be giuen, becauſe it is contrary to all the moderne obſeruations.

*What is the line of the meane mouing of the Sunne?*

**I**T is a right line drawne from the centre of the world to the Eclipticke, and equally diſtant from another line drawne from the centre of the excentrique to the centre or middeſt of the Sunne, which other line in the Theoriques of the other Planets ought to be drawn from the centre of equacion: but becauſe in the Theorique of the Sunne the centre of the excentrique, and that of the equacion is all one, the one therefore may be indifferently taken for the other: and this line of the meane mouing is marked in the third figure with the letters A. I. being paralell to the line B. K.

*What is the line of the true mouing of the Sunne?*

**I**T is a right line drawne from the centre of the world, through the centre of the Sunne to the very ecliptick, repreſented here in the third figure by the letters A. K.

*What is the arch of the meane mouing of the Sunne, and alſo what is the arch of his true mouing?*

**T**He arch of his mean mouing is an arch of the eclipticke contained betwixt the firſt point of Aries, marked  
D ked



ked with the letter E. and the line of the mean moving before described, and this arch is marked with the letters E. F. And the arch of the true moving of the Sunne, is an arch of the Eclipticke, contained betwixt the beginning of Aries, and the line of the true moving of the Sunne, which arch is marked with the letters E. K. And both these arches are alwayes to be counted from the equinoctiall point, according to the succession of the signes.

*Copernicus* maketh two kinds of this true moving of the Sunne, that is, simple, and compound, counting the simple moving from the first starre of the Rams horne, as from a beginning which is vnmouable: but he counteth the compound moving from the beginning of the vernall equinoxe, which is mouable.

*What is the yearely Anomalie or Inequalitie of the Sunnes moving?*

**I**T is an arch of the Eclipticke, contained betwixt the line of the Auges and the line of the Suns moving, according to the succession of the signes, and this Inequalitie is twofold, that is, meane and true: the meane, is that which endeth at the line of the meane moving, and is marked with the letters C. I. And the true Inequalitie is that which endeth at the line of the true moving of the Sunne, and is marked with the letters C. K. And this yearely Inequalitie is called the Inequalitie or Anomalie of the excentrique: but the followers of *Alphon-*  
*sus* doe call it *Argumentum Solis*.

*What*

*What is the equacion of the Sunnes mouing?*

**T**Hat is an arch of the Eclipticke, contained betwixt the line of the true moouing, and the line of the meane mouing of the Sunne, marked in the third figure with the letters I. K. and this arch doth make with the centre of the world the angle K. A. I. equall to the angle A. H. B: Which angle the line of the true mouing together, with the line drawne from the centre of the excentrique to the centre of the Sunne, dooth comprehend. And you haue to note, that when the Sunne is either in his Auge, or in the opposite point thereof, then there is no such arch at all, by reason that the two foresaid lines of the true and meane moouing doe at that time meet and concur in one, making one selfe line, but the said arch is greatest when the Sun is in his meane longitude, hereafter defined. When the Sunne therefore descendeth from his Auge towards the point opposite of the Auge, this arch shew his true place, taketh away the equacion from the meane moouing. But when the Sunne ascendeth from the opposite point towards the Auge, then this arch addeth so much to the meane mouing.

Wherefore sith this arch doth encrease towards the meane longitude, and going againe from thence, is deminished; it falleth out, that the moouing of the Sun, which is equall in his owne excentrique, appeareth in the centre of the world to be vnequall, and to be most slow, the Sunne being in his Auge: and the more that he descendeth from thence, his moouing waxeth by.

D ij

little



little and little the swifter. But it is equall to the meane mouing, when the Sunne is in the meane longitude, but if he be in the point opposite to the Auge, then his mouing is most swift, and it obserueth the same course, though by a contrarie way, that is, by decreasing, whilst the Sun ascendeth from the opposit point of the Auge towards the Auge.

*What call you the meane longitude?*

**T**He meane longitude may be taken two manner of wayes.

For first the point of the orbe excentrique, in which his equacion is greatest, is called the meane longitude, of which points there bee in the excentrique, two: and that meane longitude is bounded in the third figure with the right line A.H.K. which line maketh right angles with the line of the Auge in the centre A. and in that place is found the angle A.H.B. or the arch marked in the said figure with the letters I.K. on the left hand of the figure, which is the equacion in the greatest excentricitie of the Sunne, and that is two degrees,  $\frac{1}{2}^{\circ} \frac{24}{60}'$ . but in the least excentricitie the equacion is no more than one degree,  $\frac{1}{2}^{\circ} \frac{41}{60}'$ .

Secondly, the meane longitude is a point of the excentrique, in which the Sunne or any other Planet hath a meane distance from the centre of the world, that is to say, it is in the middest betwixt the greatest and least distance. For this word longitude is generally taken for the distance of any Planet from the earth, which distance is greatest, when the Planet is in his Auge, and is least when

when he is in the opposite point of the Auge: so likewise the meane longitude is taken for that distance which exceedeth the least so much as it is exceeded of the greatest, and is equall to the semidiameter of the excentrique.

Here now should follow the fourth Intention, shewing the moving of the Sunne, according to latitude: which fourth Intention, in this Theorique onely hath no place, for the Sunne neuer swarveth one jot from the Eclipticke line, and therefore that line is called the way of the Sunne, by which line all the latitudes and wanderings of the other Planets are to be measured and examined. And thus  
I end with the Theorique of  
the Sunne.





## *g* The Theorique of the Moone.

*Why doe you deale with the Moone next after the Sunne,  
sith she is the lowest Planet of all?*



Or three causes. First, for that the Moone though she hath some more varietie in her moouing than the Sunne, yet her Theorique is not so intricate as those of the rest of the Planets.

Secondly, sith the Sunne giueth light to the world by day, describing the yeares and dayes, it is meet therfore, that the Theorique of the Moone, which giueth light in the night, and describeth the months of the year, should follow next after that of the Sunne.

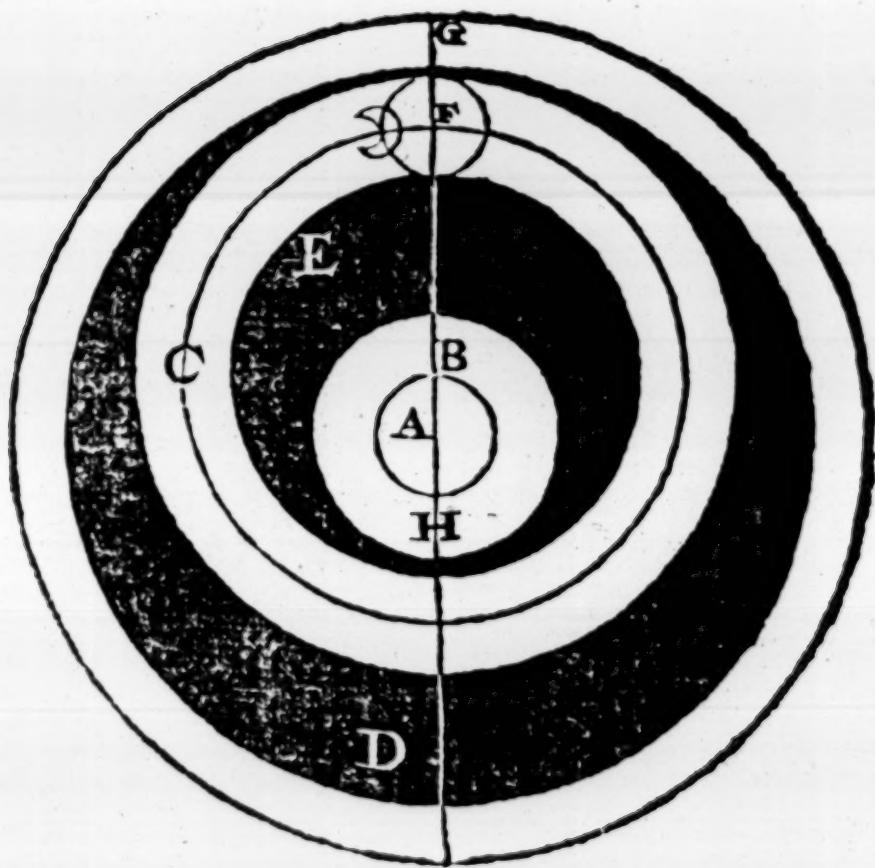
Thirdly, because all the auncient Astronomers treating of the Planets, doe place the Theorique of the Moone next vnto the Sunne, whom it becommeth vs very well to follow therein.

*The first Intention, shewing of how many orbes the  
Theorique of the Moone consisteth.*

**I**T consisteth of these five, whereof the first is the Excentrique, carrying the Epicicle: Then the two deferents of the Auges: and the fourth is the Epicicle, carrying the bodie of the Moone: (but both *Copernicus* and *Maginus*

*Maginus* do appoint to the Moone, two Epicicles, that is, the first and second Epicicle, as shall bee declared and demonstrated hereafter in my extract out of *Maginus* his Theoriques: ) and the first is the Orbe equant, enuironing all the rest of the Orbs. All which Orbs you may see plainly set downe in the figure next following, and also the two Centres, the one of the world, & the other of the excentrique, by helpe of eight letters, set downe also in the said figure, that is, A. B. C. D. E. F. G. H.

¶ *The first figure belonging to the Theorique of the Moone.*



In this figure the letter A. signifieth the centre of the world. And B. the centre of the excentrique: which centre, in going about the centre of the world, describeth a little circle



circle marked with the letters B. H.

And C. signifieth the orbe excentrique, whose middle line being described by the centre of the Epicicle, is specially to be obserued in demonstrating the motion of the Moone.

D. signifieth the vpper deferent of the Auges.

E. signifieth the nether deferent of the Auges.

F. signifieth the Epicicle, whereunto the body of the Moone is fixed.

G. signifieth the orbe equant, which is the outermost white orbe, and is otherwise called the circle or deferent of the two nods or sections, signifying the head and taile of the Dragon.

*Why do the Astronomers appoint vnto the Theorique of the Moone an orbe excentrique?*

**B**Ecause the equacions of the Epicicle which the excentrique carrieth, are obserued to bee somewhere greater, and somewhere lesser, as shall be declared hereafter in the fift Figure belonging to the Theorique of the Moone. And this apparence is to be salued by supposing an excentrique.

*Wherfore are the deferents of the Auges added to the Theorique of the Moone?*

**F**Or the selfesame causes which are before set downe in the Theorique of the Sunne.

*Why*

*Why is the Epicycle supposed to bee needfull in this Theorique?*

**F**Or two causes: First, because the Moone hath another inequality in her mouing, whereunto one onely excentrique cannot supplie: for in like and selfe-same places the motion of the Moone is found to bee sometime swifter, and sometime slower.

Secondly, because the Moone (other things beeing like) is obserued to be sometime higher from the earth, and sometime lower, which is to be seene as well by the apparant magnitude of her bodie, as also by the continuance and quantitie of her Eclipses.

*Why was it needfull to adde to this Theorique the Orbe equant?*

**F**Or two causes: First, that the varieties of the Moons latitude might be salued thereby.

Secondly, that the mouing of the excentrique, which is found to be irregular about his owne centre, might be equated or made equall by the centre of this circle, being as it were the very point of equacion, and thereof it is called the circle equant.

*Wherefore is this circle made to enuiron all the rest of the orbes?*

**T**Hough as touching the demonstration of the moouings, it maketh no great matter whether this orbe be without or within the rest of the orbes, yet sith that  
E by



by carrying about the nodes and limits of the two latitudes of the sphere of the Moone, and that by this motion the whole composition of the Moones sphere doth alter: it is more meet that this orbe should compasse in all the rest, than to be compassed of them. For it is more likely, that the inferiour orbe is mooued and turned about of his superior, than the superior of the inferior.

*The second Intention, shewing towards what part such orbes are moued, and in what time such orbes make their revolutions, and also vpon what centres or poles they make their regular moings: and first, how and in what manner the excentrique of the Moone, carrying the Epicicle, is mooued.*

**T**He excentrique of the Moone is equally mooued about the centre of the world, according to the succession of the signes, and about his owne poles, which are distant on both sides from the poles of the Eclipticke five degrees, making his revolution in the space of one moneth, and by this moouing it carrieth about the centre of the Epicicle equally through the Zodiake. And the daily moouing of this excentrique, or of the centre of the Epicicle vnder the Zodiake, is 13 degrees,  $\overset{i}{10} \cdot \overset{ii}{35} \cdot \overset{iii}{1} \cdot \overset{iiii}{7} \cdot \overset{v}{22}$ . so as his whole reuolution is made in 27 dayes, seven houres,  $\overset{i}{43} \cdot \overset{ii}{5} \cdot \overset{iii}{8}$ . and so much is the perodicall moneth, which is otherwise called of *Iohn de Sacro Busto* the moneth of peragratiō, whereof I haue spoken in my Treatise of the sphere, in the 46 chapter of the first booke thereof.

*What*

*What followeth of this inequality of the excentrique?*

**T**Wo things. First, sith that the Astronomers by often obseruation haue found, that the orbe excentrick or centre of the Epicicle dooth equally turne about the centre of the world, it must needs follow, that the moouing of the said excentrique is vnequall, as well about his owne centre, as about any other point, cleane contrarie to that which hath been said touching the moouing of the excentrique, or deferent of the Sunne. Secondly, the mouing of this excentrique is swifter, when the centre of the epicicle is in the vpper part, nigh vnto the Auge; for a greater portion thereof doth belong to the equall arches of the Zodiacke, when shee is nigh to the Auge, than when she is nigh to the opposit point of the Auge. Which things doe plainly appeare in the third and last figure belonging to the Theorique of the Sunne before described. In which figure suppose the letters F. H. G. to represent the excentrique of the Moone, whose moouing because it is equall about the centre A. must needs be vnequall about the centre B. Moreouer, because the medieties or halfe of the Zodiacke, deuided by the right line E. A. H. K. are turned about in equall time, so as the greater portion of the excentrique is answerable to the vpper halfe, & the lesser portion to the nether halfe, it easily appeareth, that the centre of the Epicicle maketh in his mouing a greater bent or bowt vpward, and a lesser downeward, that is to say, it goeth faster being in the vpper halfe, than when it is in the nether halfe.



*How are the deferents of the Auges of the Moone moued?*

**T**hey are equally moued, contrarie to the succession of the signes about the centre of the world, & about the same poles that the excentrique is, and doe make their revolution almost in 32 dayes. And by this mouing they carry about the point Auge, or the whole line of the Auge, equally through the Zodiacke, contrarie to the succession of the signes. And they also cause the centre of the excentrique to describe a little circle about the centre of the world, whose semidiameter is equall to the excentricitie, which little circle you may see in the first figure of the Moones Theorique, marked with the letters B. H enuironning the centre of the Zodiacke, marked with the letter A. And the daily mouing of these deferents of the Auge, contrarie to the succession of the signes is eleuen degrees,  $\frac{i}{12} \cdot \frac{ii}{18} \cdot \frac{iii}{21} \cdot \frac{iiii}{52} \cdot \frac{v}{33}$ . making one whole revolution in 32 dayes, three houres,  $\frac{i}{4} \cdot \frac{ii}{38} \cdot \frac{iii}{31}$ .

*How and in what manner is the Epicicle moued or turned about?*

**T**his Epicicle beeing placed in the excentrique, and eleuated aboue the centre of the Zodiacke, is moued in the vpper part of the excentrique, contrarie to the succession of the signes, and in the nether part of the said excentrique, according to the succession of the signs vpon his proper axletree, standing perpendicularly vpon the plane of the excentrique, and being moued equally from the meane Auge, maketh his revolution in 27 daies and almost in 13 houres, by which mouing the bodie of the

the Moone is carried round about the centre of the Epicicle. And the daily moouing of this Epicicle from the meane Auge, is 13 degrees, <sup>i.</sup><sub>3</sub> <sup>ii.</sup><sub>33</sub> <sup>iii.</sup><sub>56</sub> <sup>iiii.</sup><sub>23</sub> <sup>v.</sup><sub>38</sub>. so as it maketh his whole revolution in 27 dayes, 13 houres, <sup>i.</sup><sub>18</sub> <sup>ii.</sup><sub>34</sub> <sup>iii.</sup><sub>52</sub>. But for the better vnderstanding of the motion of the Epicicle, you haue to note, that there bee three speciall points belonging to the Epicicle, that is, the meane Auge, the true Auge, and the Touch-point, otherwise called the point of concauitie.

*How are these three points described?*

**T**He meane Auge is described by a right line, which being drawn from that point in the little circle, which is opposite to the centre of the excentrique, passeth through the centre of the Epicicle, euen to the circumference thereof, marked in the figure next following with the letter M.

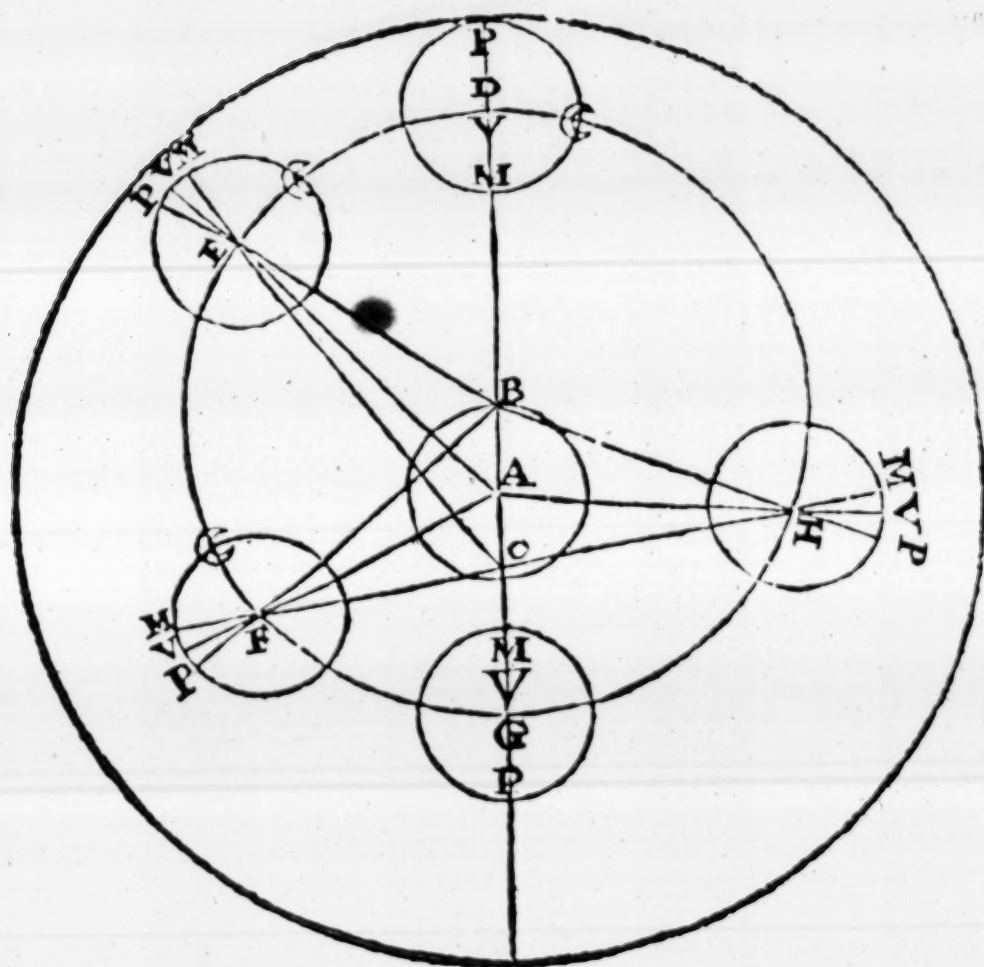
The true Auge of the Epicicle is described by a right line, which being drawne from the centre of the world, passeth also through the centre of the Epicicle, euen to the circumference thereof, and is marked with the letter V.

The point of concauitie or Touch-point is described by a right line, which beeing drawne from the centre of the excentrique, passeth also through the centre of the Epicicle, euen to the circumference thereof, marked in the figure following with the letter P. which point is called the point of concauitie, because you must imagine, that in the plane of the excentrique there is a certaine concauitie, wherein the plane superficies of the Epicicle is turned about, which concauitie of it selfe is immoua-



ble, because it is moued onely according vnto the motion of the excentrique: to the plane of which excentrique, if you attribute so much thickeſſe or deapth towards the centre therof, as is the diameter of the Epicycle, it muſt needs fall out, that the circumference of the Epicycle will touch the concaue ſuperficies of the vpper deferent of the Auges in one onely point. And therefore this point of the Epicycle may be as well called the Touch-point, as the point of concauitie: and this point is ſaid to be immouable, because it neuer changeth his place, as the other two points, that is, the meane and true Auge of the Epicycle doe; which are ſometime more or leſſe diſtant one from another, the centre of the Epicycle being out of the line of the Auge of the excentrique; for being in that line, thoſe three points are vnited, and doe meet all three in one. And the differing diſtance of the meane and true Auge of the Epicycle, in any place out of the foreſaid line, is alwaies to be meaſured by the Touch-point, because it is immouable, & not wandring as the other two points are, as you ſhall more plainely perceiue by the figure next following, and by that which ſhall be ſaid hereafter.

¶ The second figure belonging to the Theorique of the Moone.



**T**He outermost circle in this figure signifieth the Zodiacke, whose centre is marked with the letter A. and the next inner great circle signifieth the excentrique of the Moone, whose centre is marked with the letter B. which centre by going about the centre A. describeth the little circle B. C. which point C. is the opposite point to B. And the five little circles placed severally vpon the excentrique, doe signifie euery where the Epicycle of the Moone, whose centres are marked with these five letters, D. E. F. G. H. Again the right lines, marked with the letters B. P. passing through the centres of all the five Epicycles doe shew in the circumference



cumference of the said Epicles, the point of concau-  
tic, otherwise called the touch point, marked with the  
letter P. And the right lines, marked with A. V. do shew  
the true Auge of the Epicle, marked with the letter  
V. and the right lines, marked with the letters C. M.  
doe shew the meane Auge of the Epicle, marked with  
the letter M.

*What conclusions are to be gathered out of this Inequalitie  
of the Epicle?*

**T**Hese foure here following.

1 First, for so much as it is found by obseruation,  
that the motion of the meane Auge of the Epicle,  
marked with the letter M. is regular and equall, going  
every day 13 degrees and almost  $\frac{1}{4}$ . it must needs follow  
that the motion of the other two points, that is, the true  
Auge of the Epicle, marked with the letter V. and the  
touch point marked with P. is irregular and vnequall,  
because the meane Auge of the Epicle is a vagarant  
point, so called, because it keepeth not alwaies one cer-  
taine place in the Epicle, and yet is the beginning of  
the motion of the Epicle.

2 Secondly, if the centre of the Epicle be in the  
Auge or opposit Auge of the excentrique, then these  
three points, that is, the Touch-point, the true Auge, and  
the meane Auge of the Epicle be all one, that is to say,  
doe concur or meet all in one selfe line. But if the cen-  
tre of the Epicle be out of any of the said points, *viç.*  
out of the Auge or opposite Auge of the excentrique,  
then they are so seperated, as the true Auge of the Epic-  
cle marked with the letter V. is in the midst betwixt  
the

the meane Auge, marked with M, and the Touch-point marked with P, because the centre of the world is alwayes in the middest betwixt the centre of the excentrique and the point C, which point C in the little circle, is opposite to the centre of the said excentrique, marked with B. And the greatest distance of these points is beneath the meane longitudes of the Excentrique. What those meane longitudes are, shall bee declared hereafter.

3 Thirdly, in that halfe of the excentrique, which descendeth from the Auge of the said excentrique vnto the opposite Auge of the same, the two Auges of the Epicicle, both true and meane, marked with the letters V and M, doe goe before the Touch point, in respect of the motion of the Epicicle, which is contrarie to the succession of the signes. But in respect of the motion of the excentrique, which is alwayes according to the succession of the signes, the two points M and V doe follow the Touch-point P, as you may easily perceiue by the former figure last set downe: for the centre of the Epicicle being in the Auge of the excentrique, marked with D, or in the opposite Auge of the same, marked with G, the three foresaid points are all joyned together in one selfe line. But when the Epicicle descendeth from D to E, then P V and M are seperated, and P goeth before V and M: and the letter V being the true Auge of the Epicicle, is in the middest betwixt P and M. And such digression or seperation is encreased by little and little vntill the centre of the Epicicle doe come to the letter F, for from thence they begin againe to approach and to grow nigher together, vntill they fall into the point G, whereas they joyne againe, and are all one. But the



contrarie happeneth when those points are in the other ascending halfe of the excentrique, for then M and V doe goe before P, proceeding according to the succession of the signes.

4 Fourthly, the mouing of the Epicicle is swifter in the vpper part of the excentrique, than in the nether part thereof, for there the meane Auge of the Epicicle proceedeth contrarie to the succession of the signes, that is to say, towards that part into the which the Epicicle is moued: but the contrarie happeneth in the lower part of the excentrique. And you haue to note, that the Touch-point P is the measure of the digression or seperation of both the Auges of the Epicicle, as well true as meane, because the Touch-point doth at no time wander from his place but remaineth immouable.

The demonstration of this fourth conclusion is plainly set foorth in the former second figure of the Moone, whereby you may perceiue, that when the Epicicle is come to the letter H, nigh vnto the meane longitude of the Excentrique, whereas the distance of the foresaid points M V and P is alwayes greatest; then immediately both the Auges, M and V, begin againe to approach vnto the Touch-point P, wherefore M proceedeth towards P, contrarie to the succession of the signes, vntill it meeteth with P in the Auge of the excentrique, marked with the letter D. And from thence M departeth againe from P, contrarie to the succession of the signes, vntill it arriueeth to the other meane longitude of the excentrique, whereas it is furthest distant from P. And by reason that the Epicicle is also moued into that part, it falleth out, that the two moouings meeting in one selfe part, the mouing of the Moone in the Epicicle, or rather

ther the Epicicle it selfe by following the wandering meane Auge, is swifter in his gate. But contrariwise, in the nether part of the excentrique, from the place nigh vnto F (whereas the distance of M P is greatest) vnto the other place of the greatest distance of the said points nigh vnto H, the meane Auge of the Epicicle is mooued according to the succession of the signs: and there, according to the quantitie of his moouing, it taketh so much away from the swiftnesse of the Epicicle, as thereby the Epicicle in that place is much more slower in his gate.

*How is the circle equant of the Moon moued, which is otherwise called the circle of the two nodes or intersections, signifying the head and taile of the Dragon?*

**T**His circle is equally moued, contrary to the succession of the signs, about the centre and poles of the Eclipticke, making his revolution almost in 19 yeares: and by the mouing of this circle, the poles of the deferents of the Auge are carried about the poles of the ecliptick: and the daily mouing of this orbe vnder the eclipticke, is but  $\frac{1}{3}$ ,  $\frac{11}{10}$ ,  $\frac{11}{8}$ ,  $\frac{11}{23}$ , and  $\frac{1}{4}$ , so as it maketh his whole reuolution in 6798 daies, that is to say, in 18 Ægyptian years, 228 dayes, 3 houres,  $\frac{1}{49}$ ,  $\frac{11}{40}$ , and  $\frac{11}{16}$  of an houre.

*How is the moouing or departing of the Moone from these Intersections called?*

**I**T is called the moouing, or rather the Anomalie of the Moones latitude: and the Moon, or rather the centre of her Epicicle, maketh one returne to these Intersections

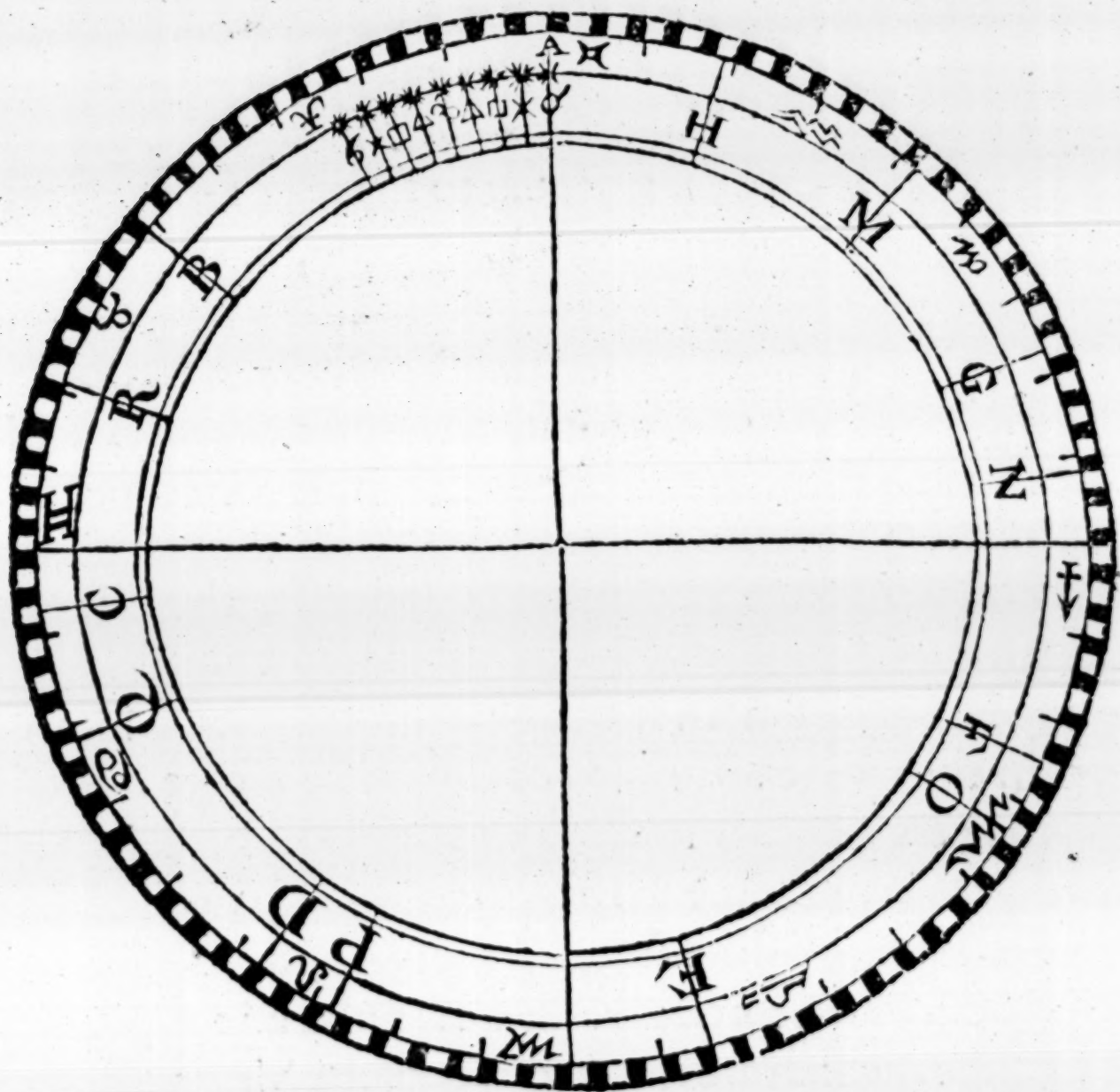


sections in 27 dayes and 5 houres, for in that time the Moone accomplisheth all the varieties and changes of her latitude both North and South, and in one day she is seperated from these Intersections 13 degrees,  $\frac{i}{3}$   $\frac{ii}{4}$   $\frac{iii}{9}$   $\frac{iiii}{30}$  and  $\frac{v}{46}$ . and maketh her returne to the said Intersections in 27 dayes, 5 houres,  $\frac{i}{3}$  and  $\frac{ii}{36}$ . of an houre.

*You said before that the motions of all the other Planets were governed by the Sunne: Tell therefore, in what moving of any Orbe belonging to the sphere of the Moone, there appeareth any harmonie or agreement of the Moone with the Sunne.*

**T**Heir harmonie consisteth in the moving of the deferents of the Auge of the Moone, and in those things which depend of those deferents. For the deferents of the Moone Auge doe keepe such proportion with the excentrique of the Moone, as looke how much the line of her meane moving by the moving of the excentrick is moued forward from the line of the meane moving of the Sunne, according to the succession of the signs, beginning at the conjunction or opposition of the said lines of the meane moving, as well of the Sunne as of the Moone: so much do those deferents carry backward the Auge of the excentrique from the same line of the meane moving of the Sunne, contrary to the succession of the signes, as you shall more easily perceiue by this figure or instrument next following, vsed by *Reinholdus* in his Commentaries made vpon the Theoriques of *Purbachius*, the description and vse whereof here followeth.

¶ The third figure belonging to the Theorique of the Moone.



**T**his figure consisteth of certaine Orbes and Circles, whereof some are moouable, and some immouable. The first lowest and greatest immouable circle being deuided into 180 parts, euery one containing two degrees, which maketh in all 360 degrees, signifieth the Zodiacke. And the limbe of this circle is deuided into two spaces, in the outermost whereof are set downe the characters of the twelue signes: and in the

F iij

inner.



innermost space are first set down above on the left hand nine little starres, each one representing the body of the Sunne. And right vnder them are set downe the first five aspects: the first whereof standing right vnder the letter A, signifieth the Conjunction of the Sunne and Moon, marked thus  $\circ$ . and next to that on the left hand, is the Sextile aspect, marked thus  $\times$ . and then the Quadrant aspect, marked thus  $\square$ . and next to that the Trine aspect marked thus  $\triangle$ . and then the Opposition, marked thus  $\&$ . and these are called the first aspects, because they go before the Full of the Moone: and then followeth againe the Trine aspect, the Quadrant, the Sextile aspect, and the Conjunction, which are called the second aspects, because they chaunce after the Full. And the first Conjunction is placed right vnder the letter A, which standing in the very top of the figure in the outermost space of the limbe, signifieth the beginning of Aries. Moreover, in the innermost space of the limbe are set downe these letters, *viZ.* B R C Q D P E O F N G M H, which letters doe serue to shew the motion as well of the Excentrique, as of the Auge of the Moone.

And next to the foresaid Zodiacke are placed 2 mouable black orbes, which are the deferents of the Moons Auge, & opposit Auge, signified by the 2 little tapes fastened to the vppermost black orbe; whereof the one tape is marked with the letter X, signifying the Moons Auge, & the other tape being vnmarked, signifieth hir opposit Auge.

Next betwixt the said two blacke orbes, is a mouable white orbe, signifying the excentrique or deferent of the Moones Epicicle, to which is put a little tape to shew the place of the centre of the Epicicle, which centre is marked with the letter Y, and in the circumference  
of

of the said Epicycle is fixed the body of the Moon. And within the Orbe excentrique is another immoouable white orbe or roundell, the centre whereof is the centre of the world, marked with the letter T, about which is a little circle described by the centre of the excentrique of the Moone, by turning round about the centre of the world, which centre of the excentrique is marked with the letter S, and the opposite point to that, is marked with the letter V, and the circumference of the said little circle is deuided into nine equall parts, marked with Arithmetical figures, as 1. 2. 3. and so forth to nine, to shew the place of the centre of the excentrique, marked with S, in euery aspect. For the centre of the Moones Epicycle being in conjunction with the Sunne, the centre S is found to be in the vpper point of the little circle, marked with the figure 1, and being in the first Sextile aspect, the centre S is in the point marked with the figure 2, and so proceedeth from point to point, according to the order of the nine aspects, before set downe.

*The vse of this Figure or Instrument is plainly shewed by this one example here following.*

**S** Vppose therefore the Conjunction of the Sun and Moone to be vnder the letter A. wherfore you must place in one selfe line both the Auge of the excentrique, marked with the letter X, and also the centre of the Epicycle, marked with the letter Y, right vnder the letter A. And because the centre of the Epicycle dooth mooue towards the left hand, according to the succession of the signes, and that the Auge of the Moone doth moue towards the right hand, contrary to the succession of the signes, you must bring the centre Y to the letter B, for



B, for there will his place be within foure dayes next after the Conjunction, and there hauing staied the centre Y, turn the Auge X towards the right hand, euen to the letter M, & stay it there, so shall you find the midde bodie of the Sun, who then followeth the Moone, to be in the middest betwixt the two letters B and M, right ouer the Sextile aspect; and at that time the Moon is said to be in a Sextile aspect to the Sunne, for then she is nigh to the meane longitudes, signified here in this figure by a white right line, alwayes crossing the line of the Auges (which is also white) in the centre of the world with right angles, and the shape of the Moones light is then horned, like a sycle, called in Greeke *Minoides*, and in Latine *Falcata*. But at the seuenth day after the Conjunction, her light will encrease somewhat more, wherefore by turning the centre Y to the letter C, and the Auge X to the letter N, you shall find the centre of the Sunne to be in the very midst betwixt those two letters, right ouer the Quadrat aspect, and the Moon to be right in the opposit Auge, and thereby to be in a Quadrat aspect to the Sunne, at which time the shape of her light is said to be halsted, which may be called the halfe Moone, in Greeke *Diachotomos*, and in Latine *Dimidia* or *Dimidiata*. But the eleuenth day after the Conjunction, she will seeme round bodied, though not at the full: wherefore you must bring the centre Y to the letter D, and the Auge X to the letter O, so shall you find the centre of the Sunne to be in the middest betwixt those two letters, right ouer the marke of the Trine aspect; for then the Moone being againe in the mean longitude, is said to be in a Trine aspect to the Sunne, and the shape of her light is round like a bowle, and may be called the whole Moon, though  
not

not the full Moone, and in Greeke it is called *Amphichyrtos*, in Latine *Vtrinque gibbosa*.

Again, when the Moone is fifteene dayes old, then bring both the centre Y, and also the Auge X to the letter E, for then you shall find the Sunne to be right ouer the marke of Opposition, so as the Moone is then opposite to the Sunne, and then she is at the full, called in Latine *Pleni Lunium*, and in Greeke *Panselmos*.






But the nineteenth day of her age the centre Y will be in the letter F, and the Auge X in the letter H, and then the Moon is the third time in the mean longitude, and then she is againe in a Trine aspect to the Sunne, as she was before at the eleuenth of her age : And when the Moone is two and twentie dayes old, then the centre Y shall bee in G, and the Auge X in Q, and then the Moone shall be again in a Quadrant aspect to the Sunne, as she was before when she was seuen dayes old. And when she is fixe and twentie dayes old, then the centre Y shall bee in H, and the Auge X in R, and then the Moone being the fourth time in the meane longitude, shall be in a Sextile aspect, as she was before, being but foure dayes old. And when she shall be thirtie dayes old, then the centre Y and the Auge X shall meet together vnder A, and so the Moone shall be againe in Conjunction with the Sunne. All which things are breiefely set downe by *Reinholdus* in this Table following, consisting of seuen Collums : In the first whereof are set down the dayes of the Moones age during her encrease, that is to say, from the Conjunction to the full, containing fifteene dayes, descending downward : in the second Collum are set the first five Aspects: and in the third Collum



the places or points of the Excentrique. In the fourth Collum the names of the Moones diuers shapes of lights, seruing as well to her encrease as decrease. In the fift Collum are set again the places of the Excentrique. In the sixt Collum the second Aspects, like to the first. And in the last Collum, the dayes of the Moones age after the full, during her decrease or wane, that is, from 15 to 30, ascending vpward.

*The Table followeth in the next Page.*

A TABLE SHEWING THE DIVERS SHAPES OF THE MOONE.

1.	2.	3.	4.	5.	6.	7.
The dates or age of the Moone.	The first fine Aspects of the Moon.	The places of the Excentrique.	The divers Shapes and names of the lights of the Moon	The places of the Excentrique.	The second fine Aspects of the Moone.	The dates.
1.	8.	In the Auge.	 <i>Comminutio</i> , the new Moone.	In the Auge.	8.	30.
4.	*	In the mean longitude of the Excentrique.	 <i>Falcata</i> , the horned Moone.	In the mean longitude of the Excentrique.	*	26.
7.	□.	In the opposite Auge.	 <i>Demi-lata</i> , the halfe Moon.	In the opposite Auge.	□.	22.
11.	Δ.	In the mean longitude of the Excentrique.	 <i>Vringgibbosa</i> , almost round.	In the mean longitude of the Excentrique.	Δ.	19.
15.	8.	In the Auge.	 <i>Plenilunium</i> , the full Moone.	In the Auge.	8.	15.



*How is this digression or departing of the Moone from the Sunne, called?*

**I**T is commonly called the longitude or mouing of the Moone from the Sunne: and the Moone returneth again to the Sunne, or rather ouertaketh him in 29 daies and one halfe day, in which time she accomplisheth all her diuers illuminations or shapes of light, that is to say, she sustaineth all her aspects to the Sunne, and sheweth to the earth all the diuersities of her lights and apparances. And this month is called the month sinodicall: for there are two kinds of Lunar months, the one periodically, in which she goeth through the whole Zodiacke, and the other sinodicall, in which she ouertaketh the Sunne; which *Sacrobussto* calleth the moneth of Consecution, who maketh foure Lunar moneths, that is, the moneth of Peragratiō, the moneth of Apparitiō, the moneth Medicinall, and the moneth of Consecution, which are all declared in the sixe and fortieth Chapter of my first booke of the Sphere. And you haue to vnderstand, that the dayly mouing of the Moone from the Sunne, contayneth 12 degrees, <sup>i</sup> 11. <sup>ii</sup> 26. <sup>iii</sup> 41. <sup>iiii</sup> 29. <sup>v</sup> 18. and the sinodicall moneth consisteth of 29 dayes, 12 houres, <sup>i</sup> 44. <sup>ii</sup> 3. <sup>iii</sup> 11.

*What conclusions doe accompanie this harmonie of the Sun and Moone?*

**T**Hese foure here following.

First, in euery meane Coniunction or Opposition of the Sunne and Moone (which meane Coniunction or Opposition is said to bee when the centre of the Moones

Moones Epicicle is either in Conjunction or in Opposition to the centre of the Sunne) the centre of the Epicicle is found to be in the Auge of the Excentrique, but in euery Quadrat aspect the centre of the Epicicle is in the opposit Auge of the Excentrique.

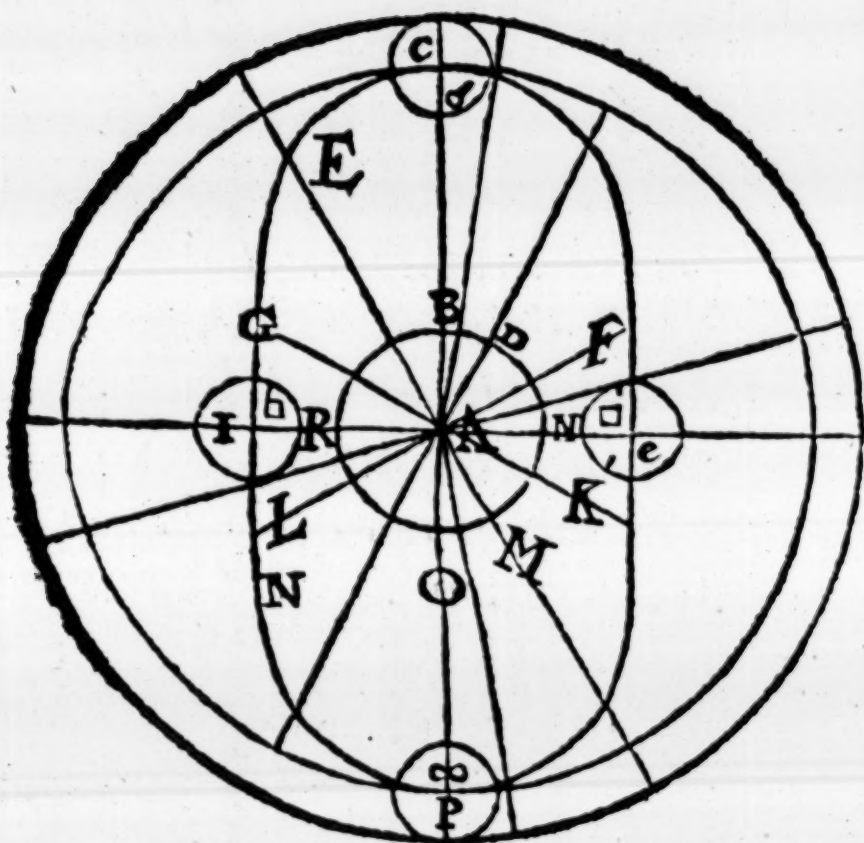
Secondly, by this means, in euery Conjunction and Opposition, as well the Excentrique as the Epicicle, are most swift in their motions ; but in the quarters they are slowest, because their Anomalie or Inequalitie is thereby altered, as hath been said a little before.

Thirdly, the Moone in one sinodicall month passeth twice through the orbe Excentrique.

Fourthly, the centre of her Epicicle in one sinodicall moneth describeth about the centre of the world a certain Ouale figure, like  
to this here following :



¶ The fourth figure belonging to the Theorique of the Moone.



**I**N which Figure, the letter A signifieth the centre of the world, or of the whole sphere of the Moon, and therefore at the new Moon the centre of the excentrique is in B, which centre B, by turning round about the centre A, describeth a little circle in the midst of this figure, marked with the letters D F N K M O R : and the foure little circles placed vpon the Ovale circle, doe signifie the Epicicle of the Moone, the foure centres whereof are marked with these foure letters, C I P E : and the letter C signifieth here also the Auge of the excentrique, and so doth the letter P, but the letters I E do each of them signifie the opposit point of the Auge. Moreover, the  
line

line A C signifieth here the line of the mean moving of the Sun, from which line when the centre B departeth towards the right hand, and commeth to the point D, which is in the little circle, then the centre of the Epicycle marked with C, descendeth on the left hand to the point E, which is in the Ovale circle, and then the angles B A D, and B A E are equall through the equalitie of their mouings. Likewise, when the centre of the excentrique commeth to the point in the little circle, marked with F, the centre of the Epicycle is in the point G. And when the centre of the excentrique falleth into the point H, and there hath described a quarter of the little circle, then the centre of the Epicycle hath likewise made a quarter of the Zodiacke, which is 90 degrees, counting from the line of the meane moving of the Sunne, whereof such distance of the Moone from the Sunne is called a quarter, and is found to be in the point I, being then in the opposit Auge of the excentrique, and so the Moone giueth light with halfe her bodie, and is then nighest to the earth. Againe, when the centre of the excentrique commeth downe into K, then the centre of the Epicycle departing from the earth, commeth to the point L: and when the centre of the excentrique commeth to the point M, then the centre of the Epicycle is in the point N. Lastly, when the centre of the excentrique falleth into O, the centre of the Epicycle shall be in P, so as O P shall be both in one right line, and thereby the centre of the Epicycle and the centre of the excentrique shall bee distant from the Sunne halfe a circle, which is a hundred and eightie degrees, and then the Moone shining with her whole bodie, is opposite to the Sun. And looke what course the Epicycle hath kept in the first half of the Ovale circle



circle during the Moones encrease, the like course it obserueth in the other halfe of the said circle, whilst the Moone decreaseth.

*How are the Orbes belonging to the sphere of the Moone, to be measured?*

**A**S the line of the Auge marked with the letters A C, or A P, in the former fourth figure, containeth 60 degrees or parts, euen so the opposit Auge, marked with the letters A I, or A Q, containeth according to *Ptolomey* of the like degrees or parts, 39 degrees and  $\frac{1}{2}$ . and the semidiameter of the excentrique, containeth 49 degrees,  $\frac{1}{4}$ . and the excentricitie A B containeth 10 degrees,  $\frac{1}{9}$ . and the semidiameter of the Epicicle containeth 5 degrees,  $\frac{1}{3}$ . But if the degrees be such, as the semidiameter of the earth containeth but one degree or one part thereof, then he prooueth by demonstration, that the line of the Auge containeth but 59 such degrees; and the line of the opposite Auge to contain no more but 38 degrees and  $\frac{1}{3}$ . and the semidiameter of the excentrique to containe 48 degrees,  $\frac{1}{11}$ .  $\frac{11}{30}$ . and the excentricitie to containe 10 degrees,  $\frac{1}{8}$ .  $\frac{11}{30}$ . and the semidiameter of the Epicicle to containe 5 degrees,  $\frac{1}{10}$ . And hereof it commeth to passe, that the altitudes of the Moone are measured by the semidiameters of the earth. For the greatest altitude of the new or full Moon, being then in the Auge of the excentrique, is 64 degrees,  $\frac{1}{10}$ . and her least altitude when she is in the said Auge, is 53 degrees,  $\frac{1}{10}$ . but the greatest altitude of the Moon, being in the beginning of any of her quarters, and in the opposite Auge of the excentrique, is 43 degrees,  $\frac{1}{3}$ . and her least

least altitude is then 33 degrees,  $\frac{1}{2}$ , of the semidiameter of the earth, whereof euery such part is equall to the semidiameter of the earth. And note, that by the altitude of the Moone is meant here a right line, extending from the centre of the earth to the centre of the Moone, in what part of heauen soeuer the be. But *Copernicus* correcting these things, in his suppositions or perticular propositions, prooueth the greatest altitude of the Moone, being either new or full, to containe 65 degrees,  $\frac{1}{2}$ , and her least altitude to containe 55 degrees,  $\frac{1}{2}$ , and being in the beginning of any of her quarters, her greatest altitude to containe 68 degrees,  $\frac{1}{2}$ , and her least altitude to containe 52 degrees,  $\frac{1}{2}$ . Such degrees, I say, whereof the semidiameter of the earth is but one.

*The third Intention, shewing what points, lines, and arches are requisit to be knowne in the Theorique of the Moone, which are these here following.*

1. **T**He line of the meane, and also the line of the true mouing of the Moone.
2. The meane and true mouing of the Moone.
3. The longitude or distance of the Moone from the Sunne.
4. The doubled longitude or centre.
5. The centre of the equalitie.
6. The Auge and opposit Auge of the excentrique.
7. The Auge and opposit Auge, both meane and true, and also the Touch-point, or point of Concauitie, all three belonging to the Epicicle of the Moone.
8. The Equacion of the Centre.

H

9. The



9. The argument equall or meane.
10. The argument equated.
11. The Equacion of the Epicicle.
12. The diuersitie of the Diameter.
13. The proportionall minutes: and to these may be added the Intersections, called the head and taile of the Dragon. Also the North and South limit, and the meane and true mouing of the same. And finally, the meane & true Anomalie or Inequalitye of the Moons latitude.

*What is the line of the meane mouing of the Moone?*

**I**T is a right line, which being drawne from the centre of the world, passeth through the centre of the Epicicle euen to the Zodiacke. And this line by meanes of the regular mouing of the excentrique vpon the centre of the world, is equally carried through the Zodiacke, shewing the meane place of the Moone, and therewith the true place of the centre of the Epicicle: which line in the sixt figure hereafter following, is represented by the letters M B, which line passeth through the centre of every one of the foure Epicicles set downe in the said sixt figure. And this line in the Theorique of the Sunne is threefold, whereof one proceedeth from the centre of the excentrique to the bodie of the Sunne, the second line being equally distant from the first, proceedeth from the centre of the world to the Zodiacke. The third line proceeding also from the centre of the world, passeth through the bodie of the Sunne to the Zodiacke. All which three lines are before plainely set downe in the second figure belonging to the Theorique of the Sun.

And

And these three lines in this Theorique of the Moone, by reason that the centre of equalitie, and the centre of the world is here all one, they doe make but one selfe line.

*What is the line of the true moouing of the Moone?*

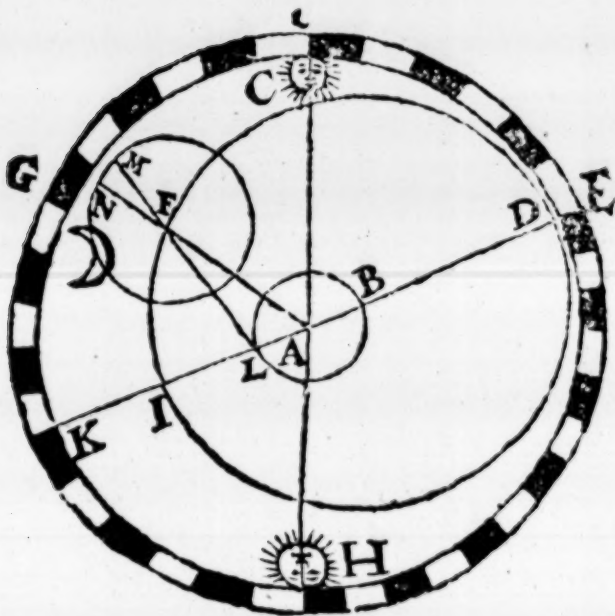
**I**T is a right line, which being drawne from the centre of the world, passeth through the midde body of the Moone, euen to the Zodiacke, which the letters M F C in the sixt figure following doe shew.

*What is the meane and true moouing of the Moone?*

**T**He meane moouing of the Moone is an arch of the Zodiacke, which extendeth from the beginning of Aries, according to the succession of the signes, vnto the line of the meane moouing of the Moone. And the true moouing of the Moone is an arch of the Zodiacke, extending in like manner from Aries to the line of the true moouing of the Moone.



¶ The fifth figure belonging to the Theorique of the Moone.



**H**is figure is vsed by *Mestelyn* to shew the armonie of the Sunne and Moone, which is alreadie more plainly demonstrated by *Reinholdus* his figure before set downe, and it is the third figure belonging to the Theorique of the Moon. And the outermost circle of this fift figure signifieth the Zodiake, diuided into 360 degrees, and the next greater circle is the excentrique of the Moone, which carrieth the Epicicle, whose centre is marked with the letter F. And A is the centre of the Zodiake: and B is the centre of the excentrique, which by turning about the centre A, describeth the little circle in the midst of the Figure, and the line A F is the line of the meane mouing of the Moone, being in G, and the line A B D is the line of the Moones Auge, or of her excentrique, being in E, and the line A C is the line of the meane moouing of the Sunne, who

who vnlesse the Moone and he be in Coniunction or Opposition, is alwayes in the middest betwixt the Auge of the Moone, and the centre of her Epicicle, as is more plainly declared before in the third figure. And therefore I haue set down this fift figure here, only to shew the longitude & double longitude of the Moone, and the equation of the centre, as followeth.

*What is the longitude of the Moone from the Sunne?*

**I**T is an arch of the Zodiacke, proceeding according to the succession of the signes from the line of the Suns meane mouing, to the line of the Moones meane mouing, which the arch C G in the former fifth figure dooth shew.

*What is the double longitude or centre of the Moone?*

**I**T is an arch of the Zodiacke, proceeding according to the succession of the signes, from the Auge of the excentrique vnto the line of the Moones meane mouing, represented in the former fift figure by the letters E C G, and is called the double longitude, because it is double so much as is the distance of the Moone from the Sun, represented in the said figure by the letters C G, as you may easily trie with your Compas. *Alphonfus* and his followers doe call it the centre of the Moone, because it dependeth vpon the Auge of the excentrique, and is answerable to that arch, which in the Theorique of the Sunne is called the yearely Inequalitie or Argument of the Sunne, which is twofold, that is, meane and true, represented in the third figure of the Sunnes Theorique



by the letters C I and C K. And this double longitude is called of *Copernicus*, *Motus secundi Epicicli*, the mooving of the second Epicicle; which second, and also the first Epicicle, shall be declared hereafter in the eleuenth chapter of my extract out of *Maginus*.

*What is the Equacion of the Centre, or of the Excentrique?*

**I**T is an arch of the Epicicle, contained betwixt the meane and true Auge of the said Epicicle, represented in the said fist figure of the Moone, by the letters M N: and whensoever the centre of the Epicicle is either in the Auge or opposite Auge of the Excentrique, then this arch is no arch at all. But if the centre of the Epicicle be out of those two points, and is found to be in that halfe of the Excentrique which descendeth from the Auge towards the opposite point thereof, then it addeth to the Inequalitie of the Epicicle hereafter defined, some portion: but in the other halfe it taketh so much away from the Inequalitie of the Epicicle, for there the meane Auge of the Epicicle goeth backward from the true Auge thereof, contrarie to the succession of the signs, towards that part into which the Epicicle tendeth; but in the first halfe it is cleane contrarie. And note, that according to the tables of *Alphonsus* and of *Ptolomey*, the greatest equacion of the centre or excentrique containeth 13 degrees,  $\frac{1}{2}$ . but according to the Prutenicall Tables, it containeth no more but 12 degrees,  $\frac{1}{2}$ . the difference whereof springeth of the diuersitie of their suppositions.

*What*

What is the *Anomalía* or *Inequalitie* of the *Epicicle*, both  
meane and true?

THE meane *Inequalitie* of the *Epicicle*, is an Arch of  
the *Epicicle*, containd betwixt the meane Auge of  
the *Epicicle* and the midde bodie of the Moone, coun-  
ted towards that part whereunto the *Epicicle* is moued:  
But the true *Inequalitie* is an arch contained betwixt  
the true Auge of the *Epicicle*, and the midde bodie of  
the Moone. This *Inequalitie* is called of *Ptolomey*, *Ano-  
malía*; of *Alphonsus*, *Argumentum*; and of *Copernicus*,  
*motus primi Epicicli*.

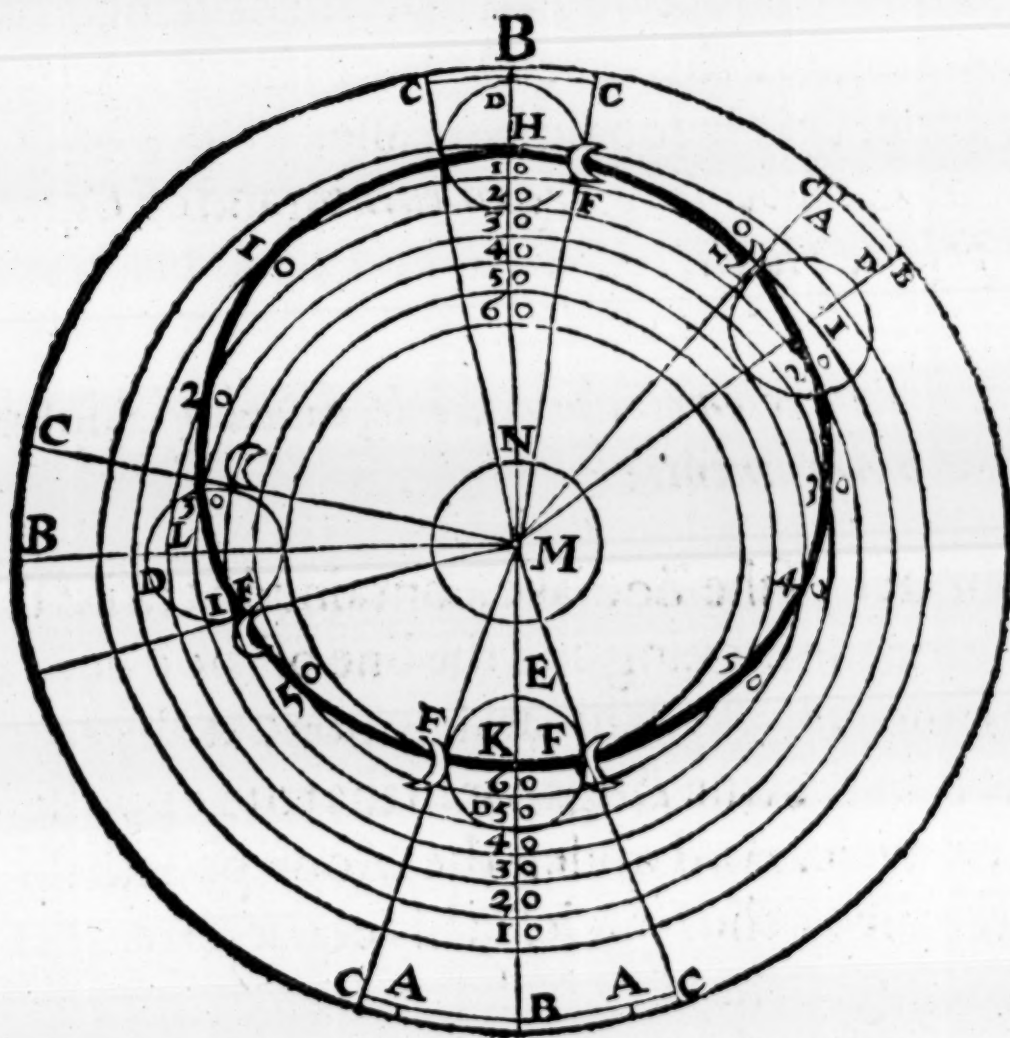
What is the equacion of the *Epicicle*, called of *Alphonsus*,  
*Equatio Argumenti*?

IT is an arch of the *Zodiacke*, contained betwixt the line  
of the meane mouing and the line of the true mouing  
of the *Epicicle*. And this arch is none at all, when the  
Moone is in the true Auge, or in the true opposit Auge  
of the *Epicicle*. And whilest the Moon passeth through  
the first halfe of the *Epicicle*, this equacion maketh the  
true mouing of the Moone lesser than her meane moo-  
uing, and in the other halfe of the *Epicicle* it maketh her  
true mouing greater than her meane mouing. And this  
equacion of the *Epicicle* may be sometime greater, and  
sometime lesser, according as the centre of the *Epicicle*  
is more or lesse distant from the Auge of the excentrick;  
but it is said to be greatest when the centre of the *Epi-  
cicle* is in the opposit Auge of the excentrique, and to be  
least when the centre of the *Epicicle* is in the Auge of  
the



the said excentrique. But to vnderstand this and many other things belonging to this equacion, it shall be necessarie to set downe this sixt figure here following, and appertaining to the Theorique of the Moone.

¶ *The sixt figure belonging to the Theorique of the Moone.*



**T**His figure as you see consisteth of certaine circles both greater and lesser, and of certaine lines and points, marked with certaine letters to shew what they signifie. You haue then to vnderstand, that the greatest and outermost circle of this figure signifieth the Zodiacke, whose centre is marked with the letter M: and the

the circle that is blacker than his fellowes, signifieth the circle excentrique, which carrieth the Epicicle of the Moone, whose centre is marked with the letter N. There be also within the Zodiake seuen other circles, all drawne vpon the centre M, making six equall spaces, euery space containing 10 minutes, so as there be in all 60 minutes, which are called the proportionall minutes; the vse whereof, and whereto they serue, we shall shew here by and by. Moreouer, there be foure little circles, signifying the Epicicle of the Moone, euery one hauing his centre placed vpon the excentrique, marked with the foure letters H I K L. And the letters B C set downe in foure sundry places vpon the Zodiake, right against euery one of the Epicicles, doe signifie the arch of the Zodiake, which is called the equacion of the Epicicle, which arch is contained betwixt the line M B, passing through the very centre of the Epicicle to the Zodiake, and the line M C passing through the midst of the Moone, marked with the letter F, betwixt which letter F and the letter D (set downe in euery Epicicle) is containd an arch of the Epicicle, whereof the arch of the Zodiake B C is said to be the equacion. And the foure letters H I K L before mentioned, doe not only signifie the centre of the Epicicle, but also certain other points in the excentrique to shew the encrease and decrease of the equacion of the Epicicle. For the point H standing aboue, signifieth the Auge of the excentrique, in which point whensoever the centre of the Epicicle is found to be, then the equacion is least, containing but 4 degrees,  $\frac{i}{56}$   $\frac{ii}{20}$ . But when the centre of the Epicicle is in the point I, then the equacion is somewhat greater: and when it is in the point L, the equacion is greater than that of I, because



the more distant from the Auge of the Excentrique, the greater is the equacion. But when the centre of the Epicicle is in the opposit Auge of the Excentrique, marked with the letter K, then the equacion is greatest of all, containing 7 degrees,  $40'$ . and the difference betwixt the greatest and least equacion, is called of *Alphonfus*, *Diuersitas diametri*, and of *Ptolomey*, *Excessus*, because the diameter of the Auge of the Excentrique, marked in this figure with the letters M H, dooth farre exceed in length the diameter of the opposite Auge of the Excentrique, marked with the letters M K, as you may easily trie with your Compas, by applying the shortest diameter K M vnto the longest diameter M H: the excessse or ouerplus whereof is deuided as you see into six equall spaces or sections, euery one containing tenne minutes, through which sections the seven circles before mentioned, doe passe, making in all sixtie minutes; which sixtie minutes are not only set downe in the right line of the Auges of the Excentrique, but also in each halfe of the circumference of the said Excentrique, proceeding on both sides downeward from the Auge vnto the opposit Auge of the Excentrique: and these sixtie proportionall minutes were inuented to know thereby how much the equacion of the Epicicle dooth encrease or decrease, according as the centre of the Epicicle is more or lesse distant from the Auge of the Excentrique. For if you suppose the centre of the Epicicle to be in the point I, then like as the diameter M I is lesse or shorter than the diameter M H, by twentie of the said minutes, so the equacion of the Epicicle marked vpon the Zodiacke with B C, is greater than the equacion of the Epicicle, beeing in H, by twentie such

mi.

minutes : which excesse is marked with the letters A C vpon the Zodiacke. Againe, when the centre of the Epicycle is in the point L, then as the diameter M L is lesser than the diameter M H by  $\frac{1}{40}$ . so is the equacion of the Epicycle, marked with B C, greater than the equacion of the Epicycle, being in H, by  $\frac{1}{40}$ . which excesse is also marked on the Zodiacke with the letters A C. And to speake breiefely, the further that the centre of the Epicycle is distant from the Auge H, the shorter is the diameter or right line drawne from the centre M to the centre of the Epicycle, and thereby the equacion of the Epicycle is the greater. Now though these proportionall minutes may be described another way, that is, by deuiding the ouerplus or excesse, whereby the arch of the greatest equacion dooth exceed the arch of the least equacion into sixtie minutes, and thereby to know the diuersitie of euery equacion, in what place soeuer of the Excentrique the centre of the Epicycle is found to bee (being out of the Auge :) yet I omit to speake thereof, because the other way before set downe, is the easier of the two, and is only the way whereby the tables of calculating the said equacions are made.

*The fourth Intention, shewing the twofold latitude  
of the Moone, and of the head and taile of  
the Dragon.*

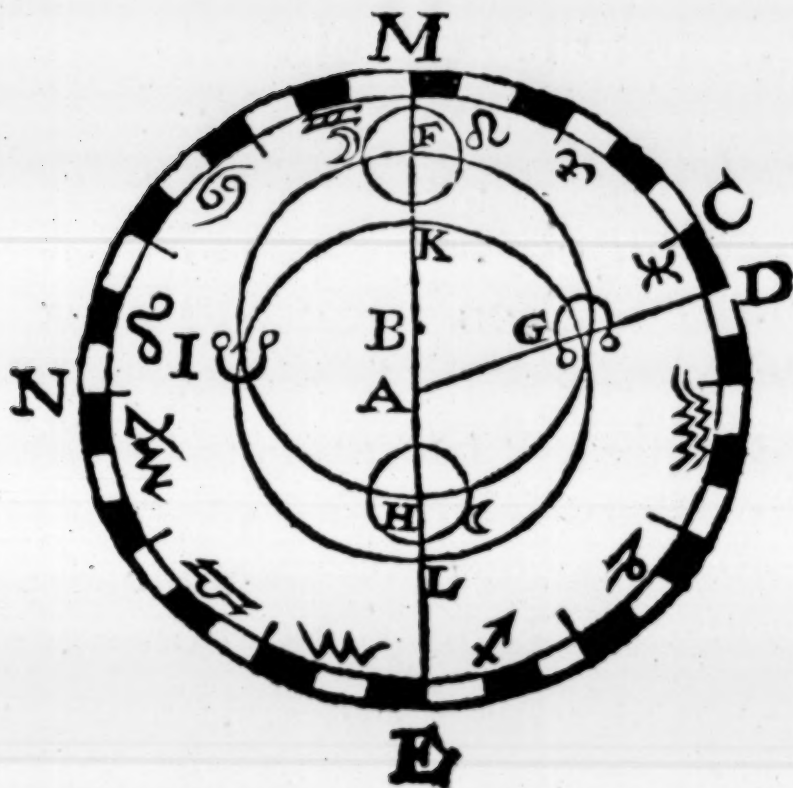
**T**He latitude of the Moone is none other thing but her distance from the Eclipticke line, which distance is neuer aboue five degrees. And her latitude is twofold, that is, Northerne and Southerne. For the



deferent of the Moone in the space of one moneth cutteth the Eclipticke in two places right opposit one to another, and thereby the one halfe of her deferent enclineth towards the North, and the other halfe thereof enclineth towards the South : and those two sections are called the two nodes, the one ascendent, which is the beginning of the Moones departing & ascending from the Eclipticke towards the North, and the other node is called the node descendent, from which node the Moon descendeth towards the South. And as the Eclipticke or way of the Sunne is deuided into foure parts by the four principall points, that is, the two equinoctiall points, and the two solsticiall points: euen so the deferent of the Moone is deuided into foure quarters by the two foresaid nodes, and by the two limits of her greatest latitude. And as the node ascendent sheweth the East, and the node descendent the West, so of the two limits the one sheweth when the Moone is farthest North, and the other sheweth when she is furthest South, as you may plainly see by the figure next following.

¶ The

¶ The seventh figure belonging to the Theorique of the Moone.



**T**He outermost circle of this figure drawne vpon the centre A, signifieth the Zodiake, hauing the characters of the twelue signes described therein, and is marked with the letters C M N E D, within which circle are drawne two other circles, crossing one another in two points opposit, whereof that which is drawne vpon the centre B, and is marked with the letters F I H G, is the excentrique or deferent, carrying the Epicicle of the Moone. And the other circle drawne vpon the centre A, and marked with the letters K I L G, signifieth the eclipticke or way of the Sunne, and these two circles are equall (because their semidiameters are equall) crossing one another in two points opposit: whereof that Intersection which is on the right hand, is called the node as-



cendent or head of the Dragon, figured thus  $\Omega$ , and that on the left hand is called the node decendent or tail of the Dragon, figured thus  $\psi$ , and the limits are marked with the two letters F H, whereof the letter F signifieth the North limit, and H the South limit. And you haue to note, that the head of the Dragon hath two motions or mouings, the one meane and the other true. His meane mouing is an arch of the Zodiacke, extending from the beginning of Aries, marked in the former Figure with the letter C, contrarie to the succession of the signes by the mouing of the orbe equant vnto the letter D, shewing the place of the head of the Dragon in the Zodiacke, whereunto the line A G doth point, which arch is marked with the letters C D. Againe, his true mouing is an arch of the Zodiacke, extending according to the succession of the signes, from the beginning of Aries vnto the head of the Dragon. And this arch is marked with the letters C M N E D, which two arches being added together, doe make vp the whole Zodiacke, and the selfesame mouings are also incident to the other three points, that is, to the taile of the Dragon, and to the two limits.

¶ *Of the Inequalitie of the Moones latitude both meane and true.*

*What is the Inequalitie or Anomalie of her latitude?*

**I**T is an arch of the Zodiacke, extending according to the succession of the signes, from the Dragons head vnto the place of the Moone: which if it be her meane place, then such arch is called the meane Inequalitie of her

her latitude: but if it be the true place of the Moone, then that arch is called the true Inequality of her latitude. How to know her meane and true place hath been shewed before.

But you haue to note, that though the followers of *Alphonſus* doe make this arch of latitude to begin at the Dragons head: euen as the Eclipticke is ſaid to begin at the vernall Equinoctiall point: yet *Ptolomey* and *Copernicus*, and alſo the Prutenicall Tables, doe make the ſaid arch to begin at the North limit of the Moones latitude, and ſo to extend, according to the ſucceſſion of the ſignes: by helpe of which arch the latitude of the Moone is alwayes to be found in the ſaid Tables.

¶ The





## **The Theorique of the three Superior Planets, that is, *Saturne, Iupiter, and Mars.***

*Why are these three called the Superior Planets?*



Ecause they are placed aboue the Sun: euen as the other three Planets, that is, Venus, Mercurie, and the Moone, are called the Inferior Planets, because they are placed vnder the Sunne, who is cheefe gouernour of them all. The Theorique of which three superior Planets, we thinke it best here to describe next after the Moone, because that though they be subject to more diuersities of mouings than either the Sunne or Moone, yet to fewer than Venus or Mercurie.

*Why are these three Planets ioined together all in one Theorique?*

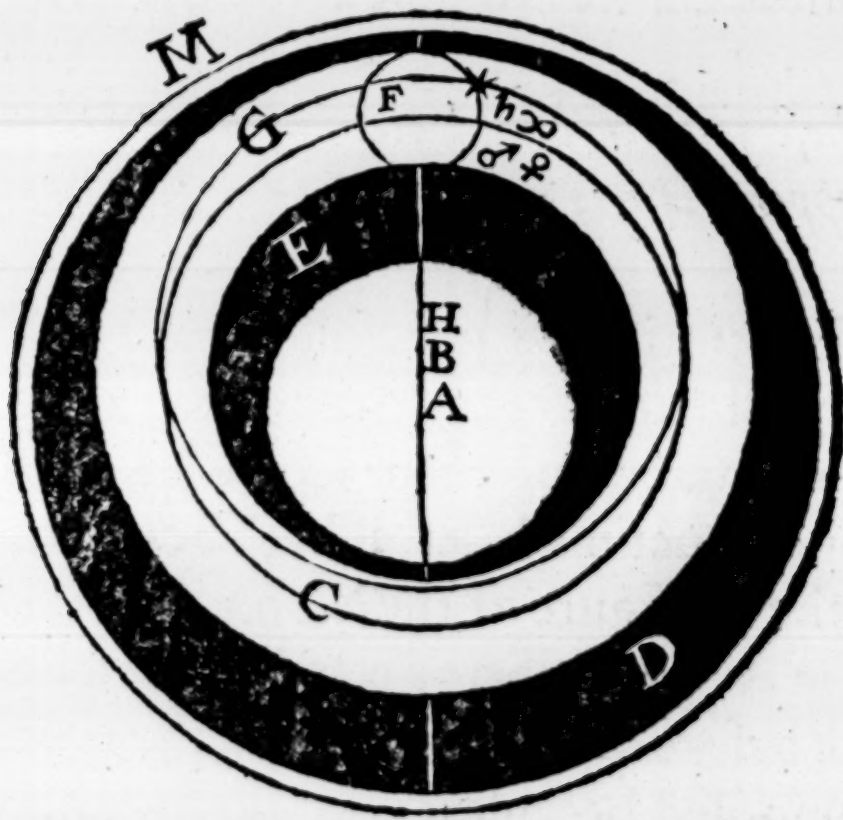
**B**Ecause in the qualitie of their moouings, as well according to longitude as latitude, they be like, differing only in quantitie, and their orbes haue like vniformitie, and therefore may be very well described in one selfe Theorique.

*The*

*The first Intention, shewing how many orbes doe belong to the Theorique of euery one of these Planets.*

**V**IZ. Foure orbes, and one circle, that is, the Excentrique carrying the Epicicle, then the two deferents of the Auge and opposit Auge of the Excentrique, and the Epicicle carrying the body of the Planet, whereto is added the circle Equant: all which are set downe in the Figure next following.

*The first figure of the three upper Planets.*



**T**His figure as you see is also enuironed with a great circle, signifying here the orbe which carrieth the two sections, called the head and taile of the Dragon, and is the outermost circle of all, marked with the letter



letter M, whose centre is the letter A, which is the centre of the world. And next to that are the two blacke deferents of the Auges, whereof the vpper deferent is marked with D, and the nether deferent with E, both which are in diuers respects concentrique with the centre of the world, and also excentrique: and within those two deferents is placed the Excentrique which carrieth the Epicicle, and the centre of the excentrique is marked with the letter B, and the little circle aboue is the Epicicle, whose centre is F, which centre by turning round about vpon the plane of the Excentrique, describeth in the very middest thereof a circle marked with the letter C, which circle is crossed in two points opposit by another circle, called the circle equant, marked with the letter G, whose centre is marked with the letter H.

*Why are these foure orbes placed in this Theorique of the three vpper Planets?*

**T**He Excentrique is needfull as well to shew their vnequall distances from the earth, as also for that the equacions of their Epicicles are sometime greater, and sometime lesser, as hath ben demonstrated before in the sixt figure of the Moon. And the two deferents of the Auges are here placed for the selfesame causes that are before declared. Againe, the Epicicle is necessarily supposed, because it is well knowne by often obseruation, that euery one of these three Planets in like and selfesame places of his Excentrique is found to haue diuerse and sundry motions, whereof they are said to be sometime swift and sometime slow, now stationarie and now retrograde; moreouer, they are sometime nigher  
to

to the earth, and sometime further off, as manifestly appeareth by the mutabilitie of their apparant greatnesse: all which apparences are salued, by supposing an Epicycle.

*Wherefore is the circle equant added to this Theorique?*

**B**Ecause the conuersions of the Excentriques and of the Epicycles of these three Planets are not obserued to be equated to their owne centres, but to some other point, which point is called the centre equant, marked in the former figure with the letter H: and because it is not needfull to appoint to that centre any peculiar orbe, sith there is no vse thereof, the Astronomers thinke it sufficient onely to describe about that centre a circle vpon the Plane of the Excentrique, equall to the circle Excentrique in euery respect; for hauing both equall semidiameters, as I said before, they must needs be equall.

*Hath the Orbe which carrieth the two nodes, no vse in this Theorique?*

**Y**Es, they may be vsed as well in the Theorique of these Planets, as in the rest. And yet because the varieties of the latitudes are obserued to proceed equally according to the succession of the signes, together with the Auges, the office of carrying the Nodes, is most commonly by the Astronomers appointed to the two deferents of the Auges, so as this orbe in this Theorique hauing none other vse, is not thought so needfull.



*The second Intention, shewing towards what part such Orbes are moued, and in what time they make their reuolutions, and also vpon what centres or poles they make their regular mouings: and first of all, how and in what manner the Excentriques, carrying the Epicicles of these Planets, are moued.*

**T**He Excentrique of euery one of these Planets, is moued according to the succession of the signes, vpon his owne proper poles, declining vnequally on both sides from the poles of the Eclipticke, and yet it moueth equally about the centre of the circle equant: and the Excentrique of Saturne is commonly said to make his reuolution in thirtie yeares, and the Excentrique of Iupiter in twelue yeares, and that of Mars almost in two yeares.

*How much is the precise dayly motion and perfect reuolution of euery one of these Excentriques?*

**T**O vnderstand this the better, you had need to remember *Copernicus* his diuision of the beginning of mouing before mentioned, which is twofold, the one compound, and the other simple. The compound mouing is to be accounted from the vernall equinoctiall point, which point of beginning is vnstable: and the simple mouing is to be counted from the first starre of the Rams horne, called of the Astronomers, The firme and stable point, or beginning of mouing: wherefore if you count from the Equinoctiall point, then the daily  
moo-

moving of the Excentrique of Saturne containeth  $\overset{\text{iii}}{3} \cdot \overset{\text{iii}}{3} \cdot \overset{\text{v}}{5}$ . that of Iupiter,  $\overset{\text{i}}{1} \cdot \overset{\text{ii}}{2} \cdot \overset{\text{iii}}{3} \cdot \overset{\text{iiii}}{4} \cdot \overset{\text{v}}{5}$ . and that of Mars,  $\overset{\text{i}}{1} \cdot \overset{\text{ii}}{2} \cdot \overset{\text{iii}}{3} \cdot \overset{\text{iiii}}{4} \cdot \overset{\text{v}}{5}$ . And one whole reuolution of Saturne, counting from the Equinoctiall point, containeth 29 Ægyptian yeares, 161 dayes, 22 houres,  $\overset{\text{i}}{1} \cdot \overset{\text{ii}}{2}$ . And the reuolution of Iupiter, counting also from the Æquinoctiall point, containeth 11 Ægyptian yeares, 315 dayes, 15 houres,  $\overset{\text{i}}{1} \cdot \overset{\text{ii}}{2} \cdot \overset{\text{iii}}{3}$ . And that of Mars containeth one Ægyptian yeare, 321 dayes, 22 houres,  $\overset{\text{i}}{1} \cdot \overset{\text{ii}}{2} \cdot \overset{\text{iii}}{3}$ . But if you count their moving from the first star of the Rams horne, then the Excentriques of these Planets will not make their reuolutions so soone, but bee somewhat longer in returning to that first point of moving, for the excentrique of Saturne will then make his reuolution in 29 Ægyptian yeares, 174 dayes, 4 houres,  $\overset{\text{i}}{1} \cdot \overset{\text{ii}}{2} \cdot \overset{\text{iii}}{3}$ . And that of Iupiter in 11 Ægyptian yeares, 317 dayes, 14 houres,  $\overset{\text{i}}{1} \cdot \overset{\text{ii}}{2} \cdot \overset{\text{iii}}{3}$ . And that of Mars in one Ægyptian yeare, 321 dayes, 23 houres,  $\overset{\text{i}}{1} \cdot \overset{\text{ii}}{2} \cdot \overset{\text{iii}}{3}$ .

*In what place is the centre of the circle equant to bee found?*

**I**N the line of the Auge of the excentrique towards the same Auge, whose distance from the centre of the world is double to the excentricitie of the excentrique: which excentricitie is the space contained betwixt the centre of the world, and the centre of the excentrique.

*What followeth upon this Inequalitie or Irregularitie of the Excentriques?*

**W**E haue shewed you before in the Theorique of the Moone, that the centre of equalitie is towards the

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opposit



opposit Auge of her Excentrique, and is all one with the centre of the earth, and thereby the mouing of her excentrique, whilest her Epicycle mooueth towards the Auge, is the swifter. But because in this Theorique of the three Planets, the centre of the equant is towards the Auge of the Excentrique, the Excentrique therfore moueth the more slowly; for a lesser portion of the Excentrique belongeth to the vpper halfe of the circle equant, and a greater portion thereof is due to the nether halfe of the circle equant, as plainly appeareth by the former figure: for if you draw a right line through the centre of the equant, so as it may cut the line of the Auge with right angles, it will deuide the circle equant into two equall semicircles, but it will deuide the Excentrique into two vnequall portions, whereof the vppermost is the lesser, and the nethermost the greater. And sith the mouing of the Excentrique is equall about the centre of the equant, and that these vnequall portions of the Excentrique do turne about the said centre in equall time, it must needs moue more slowly aboue, and more quickly beneath.

*How are the deferents of the Auges moued?*

**T**hey are mooued according to the succession of the signes, about the centre and poles of the Eclipticke, by vertue of the eighth sphere, & according to *Alphon-*  
*sus* doe make their whole reuolution in 49000 yeares, by which moouing they put forward by little and little the Auges of the Excentriques.

*How*

*How and in what manner are the Epicycles of these Planets mooved?*

**T**hey are moued in their vpper part according to the succession of the signes, and in their nether part contrarie to the succession of the signes, which is cleane contrary to the mouing of the Moones Epicycle before declared. And euery one of these Epicycles is equally mooued from his meane Auge, vpon his owne proper axletree, which is also mouable, standing vpon the plane of the Excentrique obliquely or sloopewise, and not perpendicularly. And the Epicycles of Saturne and Iupiter doe go about in the space of one yeare and a few daies more, but the Epicycle of Mars goeth about in a little more than two yeares: and by this moouing euery Epicycle carrieth about with him the bodie of his proper Planet.

*What is the daily mouing and also the periodicall reuolution of euery one of these Epicycles?*

**T**He daily mouing of the Epicycle of Saturne, is  $\overset{i}{54} \cdot \overset{ii}{4} \cdot \overset{iii}{22}$ . and that of Iupiter, is  $\overset{i}{54} \cdot \overset{ii}{9} \cdot \overset{iii}{31} \cdot \overset{iiii}{47} \cdot \overset{v}{31}$ . and that of Mars, is  $\overset{i}{27} \cdot \overset{ii}{41} \cdot \overset{iii}{40} \cdot \overset{iiii}{23} \cdot \overset{v}{19}$ . So as the Epicycle of Saturne maketh one period in 378 dayes, which is one yeare, 13 dayes, and 6 houres,  $\overset{i}{24} \cdot \overset{ii}{57} \cdot \overset{iii}{26}$ . And the Epicycle of Iupiter maketh one period in 398 dayes, which is one yeare, 33 daies, and 21 houres,  $\overset{i}{13} \cdot \overset{ii}{11} \cdot \overset{iii}{33}$ . And the Epicycle of Mars maketh one period in 779 dayes, which is two yeares, 49 daies, 22 houres,  $\overset{i}{28} \cdot \overset{ii}{57} \cdot \overset{iii}{49}$ .

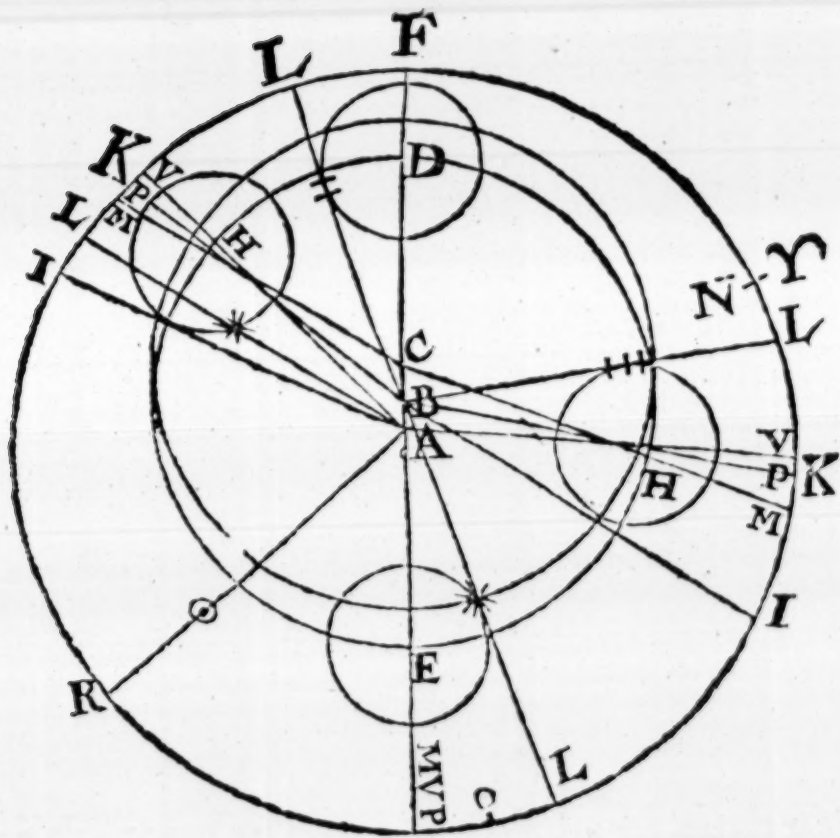
*How*



*How is the meane Auge of euery one of these Epicles described?*

**B**Y a right line drawne from the centre of the circle equant through the centre of the Epicicle, euen to the circumference thereof, making there a point marked in the figure next following with the letter M, which is furthest distant from the centre of the equant. And the centre of the equant governeth the moouing as well of the Epicicle, as of the Excentrique, as you may plainly see by this figure following.

¶ *The second figure belonging to the Theorique of the three superior Planets.*



**T**His figure consisteth of diuerse circles and centres, lines, and points, whereof the outermost circle signifieth

nifieth the Zodiacke, whose centre is marked with the letter A, and of the two greater circles drawne within that, cutting one another in two points opposit, the one is the circle equant, whose centre is marked with the letter C, and the other is the Excentrique, whose centre is marked with the letter B, and the Auge of the Excentrique is marked with the letter D, and the opposit Auge thereof is marked with the letter E : and the foure lesser circles placed vpon the Excentrique, are Epicicles, whereof two haue their centres, marked with the letter H, as well on the right hand as on the left hand of the figure, for the right line C H M dooth point to the meane Auge of the Epicicle, marked with the letter M on both sides of the figure, and the right line A H V dooth point to the true Auge of the Epicicle, marked likewise on both sides of the figure with the letter V, and the right line B H P sheweth the Touch-point, marked also on both sides of the figure with the letter P, which is alwaies in the middest betwixt the meane and true Auge of the Epicicle, being out of the line of the Auges. Now what the other letters set downe in the outside of this figure doe signifie, shall be shewed when we come to describe the points, lines, and arches, belonging to this Theorique.

*What conclusions doe follow vpon this Inequalitie of the Epicicle?*

1. **T**Hese foure : First, the moouing of the Planet to any other point in the circumference of the Epicicle, than to the meane Auge of the Epicicle and to the opposit Auge, is vnequall.

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2. Sc-



2. Secondly, when the centre of the Epicycle is either in the Auge or opposit Auge of the Excentrique, then the three points, that is, the mean Auge, the true Auge, and the Touch-point are all vnited, and doe meet in one selfe line: but beeing out of the line of the Auge, they are so seuered, as the Touch-point is in the middest betwixt the meane and true Auge of the Epicycle, because that the centre of the Excentrique is in the middest betwixt the centre of the Equant, and the centre of the Eclipticke.

3. Thirdly, in the descending halfe of the excentrique from the Auge towards the opposit Auge thereof, that is from D to E, the meane Auge of the Epicycle, marked with M, goeth before the Touch-point, marked with P, according to the succession of the signes; and the true Auge of the Epicycle followeth the said Touch-point, according to the succession of the signes. But in the other ascending halfe of the Excentrique, the true Auge of the Epicycle beeing out of the line of the Auges of the Excentrique, alwayes enclineth from the Touch-point towards the Auge of the Excentrique, and the meane Auge of the Epicycle enclineth towards the opposit Auge of the Excentrique.

4. Fourthly, in the vpper part of the Excentrique the mouing of the Planet is swifter than in the lower part of the Excentrique, because that the meane Auge of the Epicycle goeth in the vpper part of the Excentrique, according to the succession of the signes. But in the other nether halfe of the Excentrique, the mouing of the Planet is slower, going there contrarie to the succession of the signes.

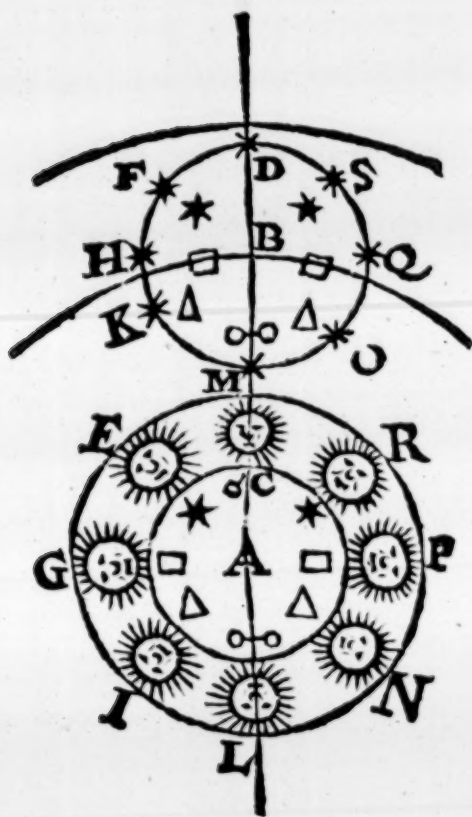
*What*

*What harmonie is there betwixt the moving of the Sunne,  
and the movings of the three superior Planets, and wher-  
of dependeth such harmonie?*

**I**T chiefly dependeth vpon the periodical reuolutions  
and mouings of their Epicicles: for it is well known by  
good obseruation, that in euery meane conjunction of  
the Sunne with any of the said three Planets, the Planet  
it selfe is in the meane Auge of his Epicicle; and in eue-  
ry meane opposition of the Sunne with any of the said  
three Planets, the Planet it selfe is in the meane opposit  
Auge of his Epicicle: and in any other place look how  
much the meane place of the Sunne is distant from  
the meane place of the Planet, so much is the Planet it  
selfe distant from the meane Auge of the Epicicle, as  
you shall easily perceiue by this figure following. What  
meane Conjunction or Opposition is, shall be decla-  
red hereafter in the second booke, treating of the passi-  
ons of the Planets.



¶ The third figure belonging to the Theorique of the three superior Planets.



**T**His figure as you see consisteth of two severall circles, wherof the lesser circle which standeth above, signifieth the Epicycle, carrying the Planet, whose centre is marked with the letter B. And the greater circle beneath, is the deferent of the Sunne. In each of which circles are set downe the characters of the five Aspects, whereof in both circles, that of the Conjunction is placed above, and that of the Opposition beneath: and on each hand on both sides are placed the characters of the other three aspects, that is, the Sextile, the Quadrat, and the Trine aspect. The letters set downe on both sides of either circle, doe serve to shew the points of moving, as well of the Sunne in his deferent, as of the Planet in his Epicycle: for when the Sunne by his meane moving  
is

is in the point C of his deferent, and the Planet in the meane Auge of his Epicicle, marked with D, then are both their meane mouings joined in one selfe line, and so be in a Conjunction. And as the Sun departing from thence to the point E, set downe on the left hand of his deferent, hath gone a sixt part of his deferent, and thereby is in the first Sextile aspect: so the Planet departing from the meane Auge of his Epicicle, and comming to the point F, hath gone also a sixt part of his Epicicle, and is thereby in the first Sextile aspect: and when the Sunne commeth to the point G, and the Planet to the point H, then they are both in a Quadrat aspect: and when the Sunne commeth to the point I, and the Planet to the point K, then are they both in a Trine aspect: and when the Sunne is in the point L, and the Planet in the point M, then they are just opposit one to another, being both in one selfe line: and in departing from thence, they obserue like order in going through the other halfe of their circles, vntill they come againe to be in a Conjunction, as the letters N P R on the right hand, being the halfe of the Sunnes deferent, and the letters O Q S on the right hand, being the halfe of the Epicicle, do shew.

*Of this harmonie doe follow three conclusions.*

1. **F**irst one period of the Epicicle is justly accomplished in so much time as passeth betwixt two Conjunctions of the Sunne and of the Planet.

2. Secondly, looke how many degrees the Sunne by his meane mouing is distant from the meane moouing of the Planet, so much doth the Planet depart from the



meane Auge of his Epicycle. And therefore the meane mouing of the centre of the Epicycle, and the meane mouing of the Planet in his Epicycle, being joyned together, are equall to the meane mouing of the Sunne.

3. Thirdly, of this way may be gathered, that the Epicycle and the Excentrique as touching their swiftnesse and slownesse of gate in making their periodicall reuolutions, are cleane contrary one to another, for in those places whereas the mouing of the Excentrique is slowest, there the mouing of the Epicycle is swiftest, and yet their mouings being all joyned together, are equall to the mouing of the Sunne.

*What measure doth Ptolomey appoint to euery one of their Orbes?*

**T**Heir measures doe depend of the semidiameter of the Excentrique, which is supposed to containe 60 parts or degrees, and of such like parts the excentricitie of the excentrique of Saturne containeth 3 degrees,  $\frac{1}{2}$ , and that of Iupiter 2 degrees,  $\frac{1}{4}$ , and that of Mars 6 degrees,  $\frac{1}{2}$ . Againe, the excentricitie of the equant of Saturne containeth 6 degrees,  $\frac{1}{2}$ , and that of Iupiter containeth 5 degrees,  $\frac{1}{2}$ , and that of Mars 12 degrees,  $\frac{1}{2}$ . And the semidiameter of the Epicycle of Saturne containeth 6 degrees,  $\frac{1}{2}$ , and that of Iupiter 11 degrees,  $\frac{1}{2}$ , and that of Mars 39 degrees,  $\frac{1}{2}$ . And the least altitude from the earth of Saturne, is 50 degrees,  $\frac{1}{2}$ , and that of Iupiter is 45 degrees,  $\frac{1}{4}$ , and that of Mars is 14 degrees,  $\frac{1}{2}$ . And the greatest altitude from the earth of Saturne is 69 degrees,  $\frac{1}{2}$ , and that of Iupiter is 74 degrees,  $\frac{1}{2}$ , and that of Mars is 105 degrees,  $\frac{1}{2}$ .

*The*

*The third Intention, shewing what points, lines, and arches are necessarie to be knowne in the Theoriques of the three upper Planets, which are these here following.*

1. **F**irst, the Auge and opposit Auge as well of the Excentrique, as of the circle equant.
2. The lines of the meane and true mouing of the Epicicle, and of the Planet.
3. The meane and true mouing of the Epicicle, and of the Planet.
4. The Inequalitie or centre of the Excentrique, both meane and true.
5. The meane and true Auge of the Epicicle.
6. The equacion of the Excentrique, or of the centre, as well in the Excentrique as in the Epicicle.
7. The inequality of commutation or argument, both meane and true.
8. The equacion of the argument.
9. The meane longitude.
10. The excesse of the longer longitude.
11. The excesse of the nigher longitude.
12. The proportionall minutes both nigher and more remote.
13. The diameter of the Auges.
14. The diameter of the mean longitude in the Epicicle.
15. The vpper and nether halfe of the Epicicle.
16. The orientall and occidentall halfe of the Epicicle, the descriptions of all which things do here follow.

But first as touching the Auges and opposit Auges, as well of the Excentrique as of the Equant, they are alreadie before described.

The



The line of the meane moouing of the Planet or of his Epicicle, is a right line drawne from the centre of the world to the Zodiake, and is a paralell or equally distant to another line, drawne from the centre of the Equant, and passing through the centre of the Epicicle. Of which two lines, the first is marked in the second Figure on the right hand thereof, with the letters A I, and the other line is marked on the same hand with the letters C H.

But the line of the true mouing of the Epicicle, is a right line drawne from the centre of the world through the centre of the Epicicle euen to the Zodiake, represented on both hands of the said figure with the letters A K.

Now the line of the true mouing of the Planet, is a right line drawne from the centre of the world through the bodie of the Planet vnto the Zodiake, signified by the letters A L set down on both sides of the said second figure. But if the Planet be either in the true Auge or opposit Auge of the Epicicle, then the two lines A K and A L are vnited. But if the centre of the Epicicle be either in the Auge or opposit Auge of the Excentrique, that is either in D or E, then the three lines A I, A K, and C H M, are all one.

The meane mouing of the Planet or of his Epicicle, is an arch of the Zodiake, extending from the vernall Æquinoctiall point, according to the succession of the signes vnto the line of the meane mouing of the Planet or Epicicle, marked in the said figure with the letters N F I, proceeding towards the left hand.

The true moouing of the Epicicle is an arch of the Zodiake, extending according to the succession of the  
signes

signes from the said *Æquinoctiall* point to the line of the true mouing of the *Epicicle*, marked with the letters N F K.

But the true mouing of the Planet is an arch of the *Zodiake*, extending in like manner from the *Æquinoctiall* point to the line of the true mouing of the Planet, marked in the said figure with the letters N F L.

And remember, that the letter N alwaies signifieth the vernall *Æquinoctiall* point, whereto is set the character of Aries.

*Of the Inequalitie of the Excentrique, both meane and true.*

**T**He mean Inequalitie of the Excentrique is an arch of the *Zodiake*, extending according to the succession of the signes, from the line of the Auge of the Excentrique vnto the line of the meane mouing of the Planet or *Epicicle*: which Inequalitie the followers of *Alphonfus* do call *Centrum medium*, marked on the left hand of the foresaid figure with the letters F I.

But the true Inequalitie of the Excentrique is an arch of the *Zodiake*, extending according to the succession of the signes, from the line of the Auge of the Excentrique vnto the line of the true mouing of the *Epicicle*; which arch is marked on the left hand in the said figure with the letters F K.

*What is the equation of the Excentrique?*

**I**T is an arch of the Excentrique, contained betwixt the line of the meane mouing and the line of the true  
M mo-



moving of the Epicicle, and is marked on both sides of the foresaid figure with the letters I K.

*What is the Equation of the centre in the Epicicle?*

**I**T is an arch of the Epicicle contained betwixt the meane and true Auge of the Epicicle, and is marked on both hands of the said figure with the letters V M. But this arch is no arch, when the centre of the Epicicle is in the Auge of the Excentrique, and it is greatest when the centre of the Epicicle is in any of the two meane longitudes. And you haue to note, that the equacion of the centre in the Excentrique, and the equacion of the centre in the Epicicle are alwaies like. Moreouer, whilest the Epicicle descendeth in the one halfe of the Excentrique from the Auge of the Excentrique, marked with D, towards the opposit Auge thereof marked with E, this equacion is taken away from the meane Inequalitie of the Excentrique, and is added to the mean argument (which is here by and by defined) so as it may make thereby and in that place, as well the equated Inequalitie of the Excentrique, as the equated argument. But whilest the Epicicle ascendeth in the other halfe of the Excentrique, it is cleane contrary: for when the right line A H V in the foresaid second figure falleth into the two parallels A I and C H M, it maketh the two angles I A H and M H V to be equall. And to the two equall angles doe belong two like arches, represented in the said figure by the letters I K, and V M, which arches or equacions are not to be added or subtracted both together. But when the one is added, the other is alwayes to be taken away, because the one cleaueth to the end, and the other

to the beginning of their circles, tending towards one selfe part.

*What is the meane and true argument ?*

**T**He meane argument is an arch of the Epicycle, contained betwixt the meane Auge thereof, and the body of the Planet, to be counted towards that part wherein to the Epicycle is mooued: which arch is represented in the said second figure by the letters M L. And the true argument is an arch of the Epicycle, contained betwixt the true Auge of the Epicycle and the body of the Planet, marked in the foresaid figure with the letters V L.

*What is the equacion of the Epicycle, or of the argument ?*

**I**T is an arch of the Zodiacke, contained betwixt the line of the true mouing of the Epicycle, and the line of the true mouing of the Planet, marked in the foresaid second figure with the letters K L: and this arch is no arch when the Planet is either in the true Auge or in the true opposit Auge of the Epicycle. And it is greatest when the Planet is in the line, which being drawne from the centre of the world, toucheth in one point the outside of the Epicycle, which line is marked in the foresaid second figure on the left hand thereof, with the letters A L, and on the right hand, with the letters A I. And note, that when the Planet is in the first halfe of the Epicycle, descending from the true Auge to the opposit Auge, it addeth this equacion to the true moouing of the Epicycle, but in the other halfe of the Epicycle it taketh so much away.

M ij

But





is marked with the letter A: and the inner blacker circle signifieth the Excentrique, carrying the Epicicle of any of the three vpper Planets, whose centre is marked with the letter B: and about that centre is placed the centre of the circle Equant, marked with the letter C. but the circle it selfe cannot fitly be made here, because it must be equall in euery respect to the Excentrique, as hath been said before. And each one of the five little circles, placed vpon the Excentrique, doth signifie the Epicicle whereto the body of any of the three Planets is fixed. And the 7 halfe circles making 6 spaces, euery space containing ten minutes, as well about as beneath the centre A, doe shew the proportionall minutes, which are partly described before in the sixt figure of the Moone, and shall be more fully againe described here.

Now, as touching the rest of the letters placed as well within the figure, as round about the same, we come now to shew their significations: for the letters E F G H do signifie the Excentrique, whose Auge is marked with the letter E, and his opposit Auge with the letter G.

*A description of the meane longitudes.*

**M**oreouer, there is a point in the middest betwixt the centre A and the centre B, marked with the letter I, through which point is drawne a right line, marked with the letters F I H, which falling perpendicularly vpon the line E A G, crosseth the same in the point I with right angles, and thereby sheweth the two meane longitudes in the Excentrique, marked with the letters F H, in which two places the centre of the Epicicle is alwaies equally distant as well from the centre B, as from



the centre A. And therefore those two points doe shew the meane longitudes. And when the centre of the Epicicle commeth to any of those two points, then the greatest equation of the Excentrique of Saturne is 6 degrees,  $\frac{i}{30} \cdot \frac{ii}{30}$ . and that of Iupiter is 5 degrees,  $\frac{i}{14}$ . and that of Mars is 11 degrees,  $\frac{i}{6}$ . But when the centre of the Epicicle is in the Auge of the Excentrique, marked with E, then the arch QR sheweth the greatest equation for Saturne to be 5 degrees,  $\frac{i}{55} \cdot \frac{ii}{33}$ . and for Iupiter 10 degrees,  $\frac{i}{30} \cdot \frac{ii}{15}$ . and for Mars 36 degrees,  $\frac{i}{54} \cdot \frac{ii}{20}$ . And when the centre of the Epicicle is in the opposit Auge of the Excentrique, marked with G, then the arch QT sheweth the greatest equation for Saturne to be 6 degrees,  $\frac{i}{38} \cdot \frac{ii}{40}$ . and for Iupiter 11 degrees,  $\frac{i}{31} \cdot \frac{ii}{30}$ . and for Mars 46 degrees,  $\frac{i}{38} \cdot \frac{ii}{13}$ .

*What be the excesses of the longer and nigher longitudes?*

**B**Efore I define what they be, it shall not be amisse to aduertise you, that both *Ptolomey*, *Purbachius*, and the followers of *Alphonsus*, in counting or measuring the equations of the Epicicle of the Moone, or of the argument (as they tearme it) they haue regard onely to the excesse of the longer and shorter diameter of the Auges of the Excentrique, which excesse they call the diuersitie of the diameter; which is plainly described before in the sixt figure belonging to the Theorique of the Moone, and therefore resort thereunto, that you may the better beare it in mind. But in the other Planets they make two excesses, whereof they call the one the excesse of the longer longitude, and the other

other the excesse of the nigher longitude. The excesse of the longer longitude, is an arch of the Zodiake, shewing the equacion of the Epicicle, when the centre thereof is in any of the two meane longitudes, marked in the Excentrique on the right hand with the letter H, and on the left hand with the letter F: for then the foresaid arch of the Zodiake is greater than that which sheweth the equacion of the Epicicle, his centre being in the Auge of the Excentrique, marked with E. But when the centre of the Epicicle is in the opposit Auge of the Excentrique, then the foresaid arch of the Zodiake which is right against the meane longitude, marked with H, is lesser than the arch of the Zodiake, which representeth the equacion of the Epicicle, his centre being in the said opposit Auge of the Excentrique, and therefore is called the excesse of the nigher longitude. And of these two excesses doe rise two sorts of proportionall minutes, that is, the longer and the nigher. All which things you shall better vnderstand, by helpe of the last fourth Figure: in which figure the arch marked with the letters Q R S on the right hand of the said figure is the arch of the Zodiake, representing the equacion of the Epicicle when his centre is in the point H, signifying the meane longitude of the Excentrique, which arch is greater than the arch marked with Q R, in the top of the Figure, shewing the equacion of the Epicicle, when his centre is in the Auge of the Excentrique, marked with E, by so much as that little portion of the Zodiake, marked on the right hand of the figure with the letters R S, doth shew, as you may easily trie with your Compasses. And the said arch Q R S is lesser than the arch Q T, standing in the lowest part of the figure, whereas the  
centre



centre of the Epicicle is in the opposit Auge of the Excentrique, marked with the letter G, by so much as the letters S T on the right hand do shew, so as in this figure the letters R S on the right hand doe shew the excesse of the longer longitude, and the letters S T on the same hand doe shew the excesse of the nigher longitude : of which two excessees doe spring the two kinds of proportionall minutes before mentioned, which doe serue to shew how much euery equacion of the Epicicle is greater or lesser than another, when the centre of the Epicicle is in any other place of the Excentrique, and is clean out of the Auge or opposit Auge, and also out of the meane longitude of the Excentrique. And as in the sixt figure of the Moone the equacions of the Epicicle in euery place of the Excentrique (his centre being neither in the Auge nor in the opposite Auge of the Excentrique) is knowne by the proportionall minutes, for that as well the excesse of the longest, as the excesse of the shortest diameter of the Auges of the Excentrique is each of them there diuided into sixtie minutes: so here likewise the said proportionall minutes are found out by deuiding the difference or ouerplus that is betwixt the diameter of the meane longitude, and the longest diameter of the Auge of the Excentrique into 60 minutes; and also by deuiding into 60 minutes the ouerplus or difference that is betwixt the diameter of the meane longitude and the shortest diameter of the Auges of the Excentrique, as you may plainly perceiue by the last fourth figure, wherein as the line A E signifying the longer diameter of the Auges of the Excentrique, exceedeth in length the diameter of the meane longitude, marked on the right hand with A H, and on the left hand with A F,

A F, by a third part and somewhat more (which excesse or ouerplus is deuided into 60 minutes:) euen so the difference or ouerplus, whereby the diameter A H or A F exceedeth the shorter diameter of the Auges of the Excentrique, marked with the letters A G, is also deuided into 60 minutes; of which the first  $\circ$ . are called the longer proportionall minutes, and the last  $\circ$ . are called the nigher proportional minutes, because they are nigher to the centre of the earth.

And according as any other right line drawne from A the centre of the world to the centre of the Epicicle, being in any other place of the Excentrique, out of the Auge or opposit Auge of the Excentrique, or out of the mean longitudes, is longer or shorter; so doth the equacion of the Epicicle encrease or decrease: For as by supposing the centre of the Epicicle to be in the point K of the Excentrique, you shall find the right line A K to be longer than the line A H by 40 minutes; euen so the equacion of the Epicicle in K, marked with Q S, is lesfer than the equacion of the Epicicle in the point H, marked also with Q S, by 40 of such minutes, as the little arch R S, signifying the excesse of the longer longitude, doth containe 60 minutes. Likewise, as the line A L is shorter than the line A H by 40 minutes, euen so the equacion of the Epicicle, marked with Q S (his centre beeing in L) is greater than the equacion of the said Epicicle, marked also with Q S, his centre beeing in the point H, by 40 of such minutes, as the arch S T, signifying the nigher longitude, dooth containe 60 minutes. And remember here, that in seeking in this figure to know the length of the line A K by the minutes, you must put the firme foot of your Compas  
N in



in the centre A, and the moouable foot in the point L, and so to draw the moouable foot from thence to the line A H Q, vpon which line the numbers of the 60 proportionall minutes are set downe : and to know the length of the line A L, you must fit your Compasses to A L, and then draw the mouable foot to the line A G Q, vpon which line are also set downe the 60 proportionall minutes, in like manner as they are vpon the line A H Q, sauing that in the line A H Q the said 60 minutes are to be counted from H towards Q, and in the line A G Q they proceed vward from Q to G, according as the inferior halfe circles doe shew. And after this manner you must deale, to know the length of any other line drawne from the centre A to any other point of the Excentrique, whereinto the centre of the Epicycle chaunceth to fall; considering alwayes whether such line be either longer or shorter than the line A H, passing through the point of the meane longitude, to the intent you may know thereby how to applie the length of euery line to the right number of the proportionall minutes belonging to the same. But you haue to note, that neither *Copernicus* nor the Prutenicall tables doe make any more kinds of excesses or proportionall minutes, but that onely which is plainly declared before in the sixt figure of the Moone.

*What is the diameter of the Auges in the Epicycle?*

**I**T is a right line passing through the centre of the Epicycle, and also through the true Auge and the true opposit Auge of the said Epicycle : which line deuideth the plane of the Epicycle into two equall halfes, whereof the  
one

one is called the Orientall halfe, and the other the Occidentall halfe, hereafter described in the sixt figure.

*What is the diameter of the mean longitudes in the Epicicle?*

**I**T is a right line drawne through the centre of the Epicicle, erected perpendicularly vpon the diameter of the true Auges of the said Epicicle next before defined: and when the Planet falleth into this line, it sheweth the meane distance that is betwixt the greatest longitude in the Auge of the Epicicle, and the least longitude in the opposit Auge of the said Epicicle, and thereof is called the diameter of the meane longitudes. And this line deuideth also the plane of the Epicicle into two halfe, that is, the vpper halfe, and the nether halfe. The vpper halfe is that which is aboue the diameter of the meane longitudes, and is farthest from the earth: and the lower or nether halfe is beneath the said diameter, and is nigher to the earth.

*What is the Orientall and Occidentall halfe of the Epicicle?*

**T**He Orientall halfe is that, which being contained betwixt the Auge and opposit Auge, looketh towards the East: and the other halfe looking towards the West, is called the Occidentall halfe. And you haue to note, that as well in these three Planets, as in the other two Planets next following, that is, Venus and Mercurie, the first halfe of the Epicicle is Orientall, and the later halfe Occidentall: but in the Moone the later halfe of her Epicicle is Orientall, and the first halfe thereof is Occidentall, For the Epicicle of euery one of the fore-



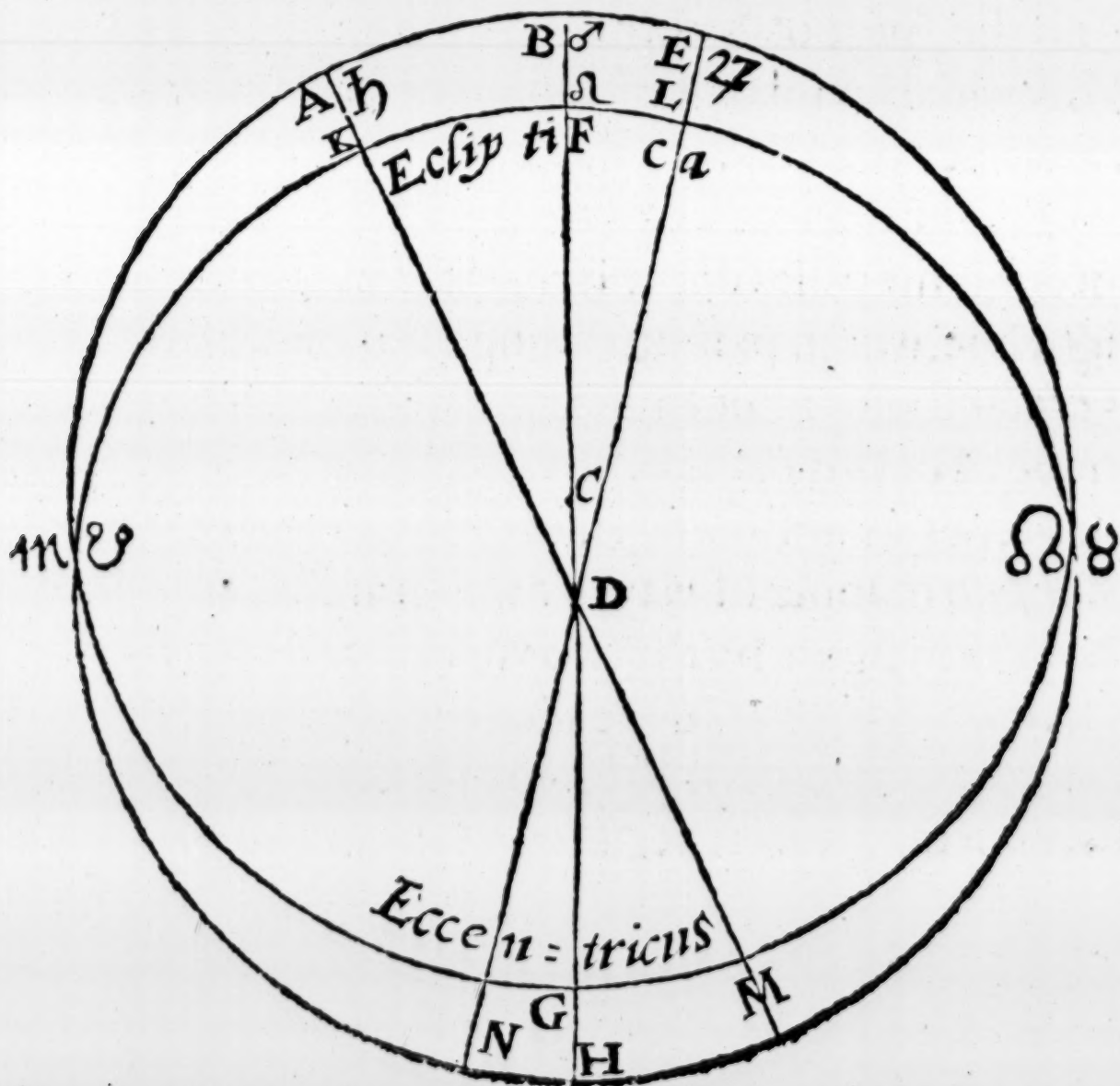
saide five Planets going from the Auge, in his vpper part, according to the succession of the signes, carrieth the Planet first into the Orientall halfe: but in the Moone it is cleane contrarie.

*The fourth Intention, shewing the twofold latitude of the three vpper Planets, and wherein their latitude differeth from the latitude of the Moone.*

**T**He latitude of the Moone is simple, hauing onely respect to the distance of her Excentrique or Deferent, from the Eclipticke line; whose greatest distance from thence, either toward the North or South, is but five degrees, as hath been said before, by reason that the poles of her Excentrique are distant from the poles of the Ecliptick no more but five degrees. But the latitude of the three vpper Planets is to be considered two manner of waies: First, according to the distance of any of their excentriques from the Eclipticke: and secondly, according to the distance of any of their Epicycles from the Excentrique thereof, which two kinds of latitude *Purbachius* describeth the first in this manner: The first (sayth he) chaunceth by reason that the plane or superficies of the Excentrique of the Planet declineth from the plane of the Eclipticke in two parts opposit, the greatest distance of such declination remaining alwaies invariable like as in the Moone, and yet the two Nodes or Intersections, that is to say, the node ascendent and descendent, otherwise called the head and taile of the Dragon, are not moued contrary to the succession of the signes (as in the Moone) but according to the mouing of the eighth sphere, so as the Auges of the deferents of those Nodes do

do describe on the North side, paralell circumferences that be equally distant from the Eclipticke: and though such Auges be alwaies septentrionall, yet notwithstanding those Auges be not in all the three planets the very points or limits of the greatest latitude of their deferents from the Eclipticke; yea that falleth out only in Mars, the Auge of whose excentrique doth most decline from the Eclipticke to the North; but in Saturne the point or limit of his greatest latitude goeth before the Auge of his excentrique, contrary to the succession of the signes, and is distant from his Auge 50 degrees; and in Iupiter such point goeth after the Auge of his excentrique according to the succession of the signes, and is distant from his Auge 20 degrees. All which things you shall more plainly perceiue by this figure here following, set downe by *Reinholdus* in his *Comment vpon Purbacchius*.

¶ The fifth figure of the three superior Planets.







**I**N this figure the letter D signifieth the centre of the world, whereupon is drawne a circle signifying the plane of the Eclipticke: and the said point D, representeth also both the poles of the Eclipticke. And vpon the point C is drawn another circle, signifying the plane or superficies of the excentrique, marked in the vpper part with the letters A B E, enclining as you see towards the plane of the Eclipticke. And because the two planes, that is, the plane of the Excentrique & the plane of the Eclipticke doe crosse or cut one another in the very centre of the world, marked with D; and because the Auges of the three Planets are all distant from the Eclipticke towards the North; therefore the centres of their Excentriques must needs be also Northerly, and out of the centre of the Eclipticke: so as the centre of the Excentrique for Saturne, is to be found in the line A D, and for Mars, in the line B D, and for Iupiter, in the line E D. And the Auge of Saturne is marked with A, and that of Mars with B, and that of Iupiter with E. Moreouer, the right line, marked with the letters B F C G H, representeth the plane of the greatest circle, passing as well through the poles of the Eclipticke, as also through that right line, which passing through the centre of the world is erected with right angles vpon the plane of the excentrique: For this plane of the greatest circle doth deuide the arches, as well of the Excentrick, as also of the Eclipticke, two manner of wayes: which arches are distinguished in this figure by the two vsuall characters, signifying the two nodes, otherwise called the head and taile of the Dragon: and either of the two distances, F B, or G H, sheweth the greatest declination of the two planes. And finally,



finally, the point B is the limit of the North latitude, and G the limit of the South latitude of any of the three Planets. Thus you may perceiue, that the Auge of the Excentrique of Mars is alwayes in the North limit, and his opposite Auge in the South limit, but the Auge of Iupiters Excentrique, marked in the former Figure with E, goeth before the North limit B, that is to say, the centre of Iupiters Epicycle commeth to the Auge of his Excentrique, before that it arriueth to the North limit. And finally, the Auge of Saturne his Excentrique, marked in the said figure with A, followeth after the North limit, so as the centre of his Epicycle arriueth to the North limit, before it commeth to the Auge of his Excentrique. And the followers of *Alphonfus* do make the Node ascendent of Mars to be at this day in the sixteenth degree of Taurus, and his Node descendent to be in the sixteenth degree of Scorpio: and the Node ascendent of Iupiter to be in the 14 degree of Cancer, and his Node descendent to be in the 14 degree of Capricorne, and his North limit to be in the 14 degree of Libra. And the Node ascendent of Saturne to be in the 24 degree of Cancer, and his Node descendent to be in the 24 degree of Capricorne, because his North limit is in the 24 degree of Libra, so as there is no great difference betwixt Saturne and Iupiter, touching their limits. And partly hereby, and partly by that which followeth hereafter, it shall manifestly appeare that Saturne whilest he passeth through the one halfe of the Zodiacke, counting from the 24 degree of Cancer vnto the 24 degree of Capricorne, he hath alwaies North latitude; and whilest he passeth through the other halfe of the Zodiacke, he hath alwaies South latitude. Wherefore  
confi.



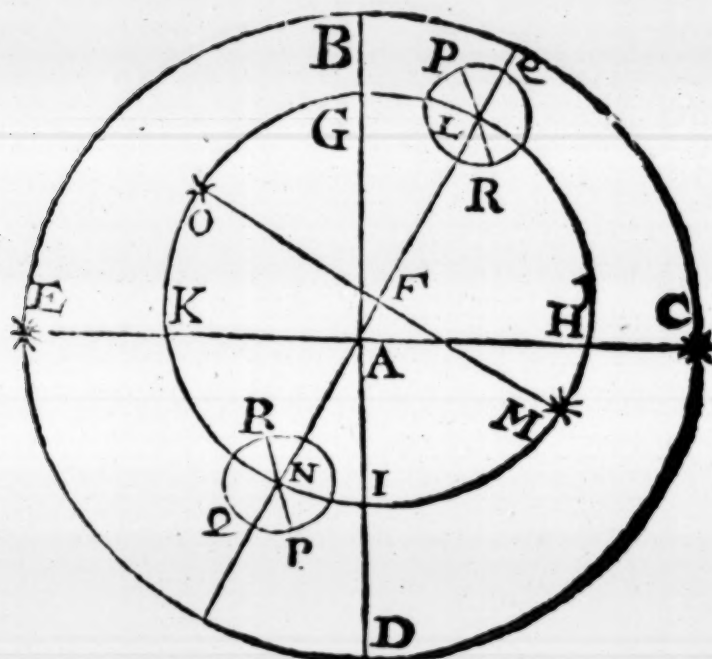
considering that he maketh his whole reuolution in thirtie yeares, he hath continually during the space of 15 yeares North latitude, and during the other 15 yeares South latitude: and the like is to be judged of Iupiter and Mars, according to the time of their entire reuolutions; for Iupiter maketh his reuolution in 12 yeares, and Mars in 2 yeares.

But *Mestlyn* following *Copernicus*, setteth down the places of the North limit and Node ascendent of euery one of the three vpper Planets in this manner, that is to say, the North limit of ♄ to be in these daies in the 9 degree,  $10^{\circ}$  of ♈, and that of ♃ to be in the 26 degree,  $40^{\circ}$  of ♈, and that of ♁ to be in the 28 degree,  $14^{\circ}$  of ♈. Again, the node ascendent of ♄ to be in the 9 degree,  $10^{\circ}$  of ♈, and that of ♃ to be in the 26 degree,  $40^{\circ}$  of ♈, and that of ♁ to be in the 28 degree,  $14^{\circ}$  of ♈. And as for the South limit and the node descendent of euery Planet, each one doth occupie in the Zodiacke such degree and minute as is opposit to the place of the North limit, and of the node ascendent of euery one of the said Planets before set downe. And *Mestlyn* sayth, That as the greatest latitude of the Moone either North or South from the Eclipticke, is only five degrees, so he appointeth to the greatest latitude of the Excentrique of ♄ from the Eclipticke but 2 degrees,  $30^{\circ}$ , and to that of ♃ 1 degree,  $30^{\circ}$ , and to that of ♁ 1 degree,  $0^{\circ}$ .

Now to shew the second manner of latitude belonging to the three vpper Planets, caused by the enclining of the true Auge of the Epicicle from the Excentrique, I mind therein to follow *Mestlyn*, who affirmeth that kind of latitude to be twofold, whereof the one is called Inclination, and the other Reflexion: neither of them being fixed,

fixed, but mutable, and yet proportionable to the period of their Excentriques, for the better vnderstanding whereof he setteth down this figure following.

¶ *The sixt figure belonging to the three vpper Planets.*



**I**N which figure the centre A is the centre of the world, whereupon is drawne the outermost circle, signifying the plane of the Zodiacke, marked with the letters B C D E, passing through the poles of the Ecliptique, marked with the letters C E. Then vpon the centre F is drawn another circle, signifying the plane of the Excentrique, marked with the letters G H I K, passing through the poles of the Excentrique, marked with the letters M O, and also through the North limit, marked with L, and through the South limit, marked with N; and the two little circles placed vpon the Excentrique, each of them signifieth the Epicicle. And you haue to note, that the plane of the motion of the said Excentrique is signified here by the right line, marked with

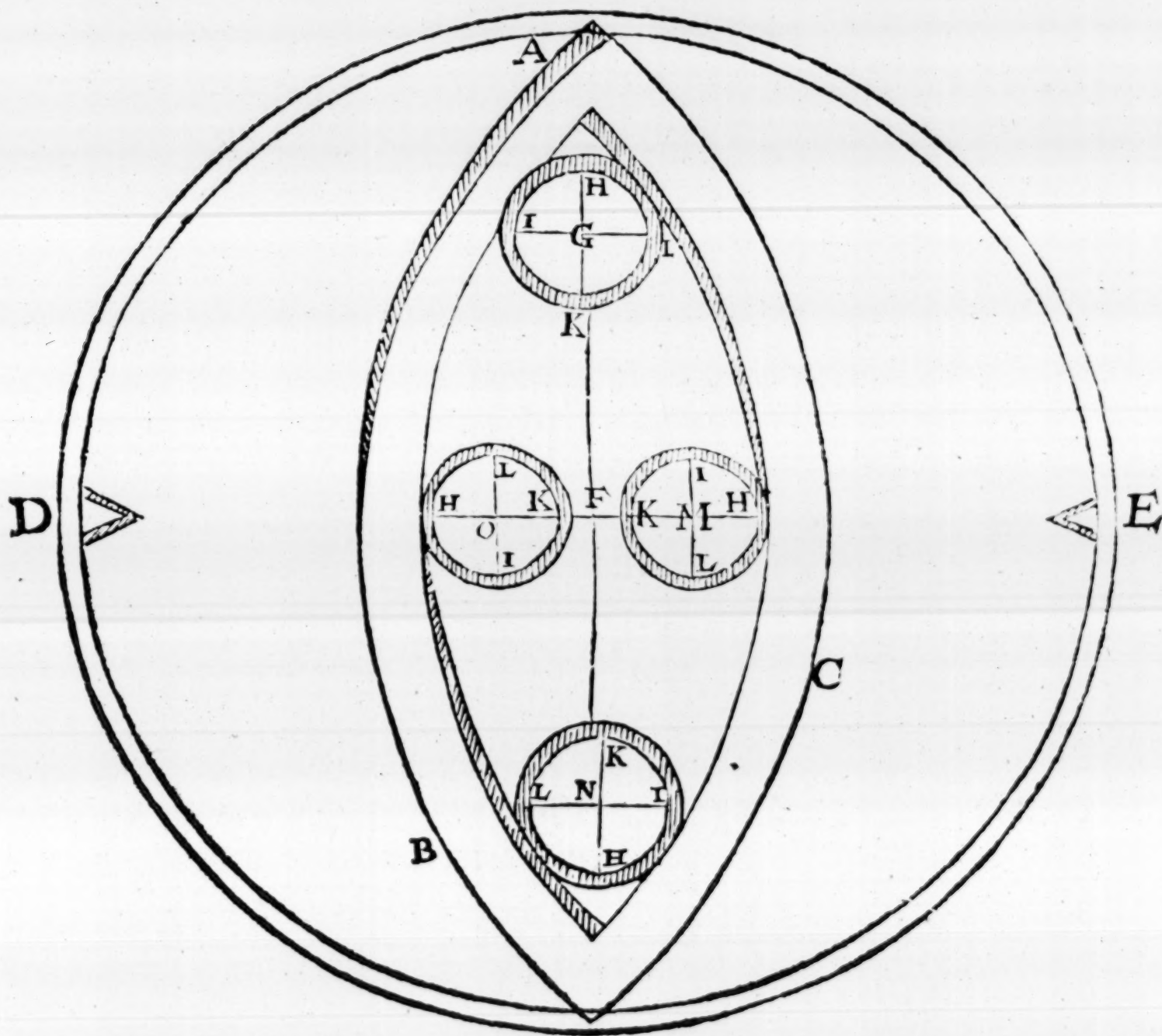


with the letters L F N, which cutteth the Eclipticke in the centre A; so as when the centre of the Epicycle is in L, it hath then his greatest North latitude, likewise being in N, it hath his greatest South latitude: and by this Figure you may perceiue, that the one pole of the Excentrique is more distant from the pole of the Eclipticke than the other, for O is more distant from K, than H from M. The signification of the rest of the letters wherewith the Epicycles are marked, shall be declared hereafter. In the meane time we will speake first of the latitude, called the Inclination of the Epicycle, in Greeke *Enclisis*, which causeth the diameter of the Auges of the Epicycle to decline on both sides of the plane of the Excentrique, that is to say, as well inwardly as outwardly, in manner and forme following: for when the centre of the Epicycle is in any of the two Nodes, the diameter of the Auges doth not decline at all either from the Excentrique or from the plane of the Eclipticke, because then it falleth just into their mutuall section. But when the centre of the Epicycle departeth from any of the Nodes, then in the vpper halfe of the Excentrique, containing the Auge of the Epicycle, the foresaid diameter of the Auges declineth inwardly from the Excentrique towards the plane of the Eclipticke, and yet arriueth not to the same. But when the centre of the Epicycle is in the nether halfe of the Excentrique, containing the opposit Auge of the Epicycle, the diameter of the Auges declineth outwardly from the Excentrick towards the Eclipticke, and yet arriueth not to the same. And the greatest declination of this diameter is when the centre of the Epicycle is in any of the limits; and yet such declination is nowhere so great, as that being out of the Nodes, it  
can

can reach vnto the Eclipticke: and this declination maketh his reuolution vpon the diameter of the mean longitudes. The most part of which things you may see plainly set forth in the sixt figure before described, in which both the Epicicles are marked with the letters P Q R, whereof P signifieth in either of the Epicicles the Auge, and R signifieth the opposit Auge of the Epicicle, and the arch P Q signifieth the greatest Inclination of the diameter of those Auges to the Excentrique. So as when the centre of the Epicicle is in the North limit marked with L, the foresaid Auge P declineth inwardly from the plane of the Excentrique towards the Eclipticke, and R the opposit Auge fleeth outwardly from the Eclipticke. But when the centre of the Epicicle is in the South limit, marked with N, then the Auge P being on the other side of the Excentrique, declineth againe towards the Eclipticke, and R the opposit Auge occupieth the opposit place to P. And you haue to vnderstand, that the greatest declination here signified by the arch P Q for  $\pi$  containeth 4 degrees,  $\frac{1}{30}$ . and for  $\pi + 2$  degrees,  $\frac{1}{30}$ . and for  $\pi - 2$  degrees,  $\frac{1}{30}$ . And to the intent that you may the better conceiue all the varietie of the foresaid Inclination, *Mestlyn* setteth downe this other Figure here next following, which also serueth to demonstrat the second kind of latitude, called Reflexion, in Greeke *Loxasis*, hereafter by him plainly described.



¶ The seventh figure belonging to the Theorique of the three upper Planets.



**I**N this figure vpon the centre F, signifying the centre of the world, is drawne a great circle, which signifieth the whole sphere of the Planet, whose poles are marked with D E, whereof D is the North pole, and E the South pole. And within this circle are drawne two other oblique circles of shape, ovale; whereof the outermost mar-

marked with the letters A B C, signifieth the Ecliptick: and the inward circle signifieth the Excentrique, whereon are placed foure Epicles, the highest whereof hath his centre marked with G, signifying here the North limit; and the centre of the lowest Epicle is marked with N, signifying the South limit; and the centre of the Epicle on your right hand is marked with M, signifying the Node ascendent; and the centre of the Epicle on your left hand is marked with O, signifying the Node descendent. Moreouer, euery Epicle is crossed with two diameters, whereof that which is marked with H K, doth signifie in euery Epicle the line of the Auges of the Epicle, that is to say, H the Auge, and K the opposit Auge; and the other diameter marked with I L, signifieth the line of the meane longitudes. Wherefore whensoever the centre of the Epicle is in the Node ascendent, marked with M, then there is no Inclination of the diameter of the Auges, because it falleth into the common Interfection, as well of the Excentrique as of the Eclipticke: but the more that the diameter of the Auges departeth from thence towards the North limit, the more it falleth vpon the line of the meane longitudes, marked with I L, insomuch, as when it arriueth to the North limit, marked with G, the inclination then is greatest, and the line of the Auge falleth directly and perpendicularly vpon the line of the meane longitudes, and from thence the inclination decreaseth, vntil the diameter of the Auges arriueth to the Node descendent, marked with O, in which point it hath againe no declination. But departing from thence towards N, the inclination of this diameter goeth vnto the other side of the Excentrique. For as the Auge of the Epicle passing first from

O iij

M through



M through G into O, declineth from the plane of the Excentrique towards E the South pole: even so departing from O, and passing through N to M, it declineth towards D the North pole: and so the Auge H is found againe to encline to the Eclipticke: and K the opposite Auge to flee from the same vntill it hath his greatest declination, which is in the point N, and from thence it returneth to M, & there again hath no declination at all.

*Of the second latitude, caused by the Epicicle, called the Reflexion.*

**B**Y this Reflexion the diameter of the meane longitudes of the Epicicle, marked in the former seventh figure with the letters I L, reflecteth or turneth backward, as well within as without the plane of the Excentrique, sauing that when the centre of the Epicicle is in any of the limits, for then this diameter falleth just and wholly vpon the plane of the Excentrique, but when the centre of the Epicicle departeth from any of the limits, then the Occidentall halfe of this diameter turneth inwardly within the plane, as well of the Excentrique as of the Eclipticke; and the Orientall halfe of the said diameter turneth outwardly, that is, on the outside of both the said planes. What the Occidentall and Orientall halfe is, hath beene described before in the third Intention. And note, that the greatest reflexion of this diameter chanceth when the centre of the Epicicle is in any of the Nodes, which greatest reflexion for Saturne, is 2 degrees,  $2^{\circ}$ . and for Iupiter one degree,  $1^{\circ}$ . and for Mars one degree,  $1^{\circ}$ . And this greatest reflexion is like vnto the greatest obliquitie or latitude of the Excen-

Excentrique from the Eclipticke, as is before set downe. Moreouer, you haue to note, that as in the former kind of latitude, called Inclination, the diameter of the Auges of the Epicycle maketh his reuolution vpon the diameter of the meane longitudes; so in this second kind of latitude called Reflexion, the diameter of the mean longitudes maketh his reuolution vpon the diameter of the Auges. And for the better vnderstanding of that which hath been said here touching the reflexion of the diameter of the meane longitudes, marke well the former seuenth figure, in which you may see, that when the centre of the Epicycle is in the North limit, marked with G, the diameter of the meane longitudes, marked with I L, lieth full vpon the plane of the Excentrique, without any reflexion. But when the centre departeth from thence, then the Occidentall halfe of the said diameter, contained betwixt the centre and the letter L; bendeth inwardly towards the South pole, and this Occidentall halfe still remaineth within the Eclipticke and within the Excentrique, vntill the centre of the Epicycle falleth into the Node descendent, marked with O, in which place the said diameter hath his greatest reflexion, and euen there is vnited to the plane of the Eclipticke. And the centre of the Epicycle departing from thence the said Occidentall halfe, remaining out of the Eclipticke and out of the Excentrique, approcheth againe to the plane of the Excentrique, and is vnited to the same in the point N: but in the other Orientall halfe it happeneth cleane contrarie.

*What*



*What conclusions doe follow vpon these two kinds of latitudes, called the Inclination and Reflexion.*

1. **T**Hese seuen here following: for first, whensoever the centre of the Epicycle is in any of the Nodes, then the whole plane of the Epicycle falleth into the plane of the Eclipticke, for then the diameter of the Auges of the Epicycle is also there, hauing no Inclination at all. And then there is also the diameter of the meane longitudes of the Epicycle, whose obliquite from the Excentrique, is alwaies so much as is the obliquite of the Excentrique from the Eclipticke. But the Epicycle is neuer vnited to the plane of the Excentrique, because neither of the foresaid diameters doe decline both at once from the plane of the Excentrique.

2. Secondly, the centre of the Epicycle being in any of the Nodes, the axletree of the Epicycle standeth perpendicularly vpon the axletree of the Eclipticke, from which it is then equally distant. But it is not equally distant to the axletree of the Excentrique.

3. Thirdly, hereof may be gathered, that the planes of the Excentriques and of the Epicycles doe cut one another alwaies in a diuers diameter, for in the two nodes such section is made vpon the diameter of the Auges, but in the two limits such section is made vpon the diameter of the meane longitudes: and in all other meane places betwixt the said nodes and limits, such section chanceth sometime in one place, & sometime in another.

4. Fourthly, the line of the mutuall section, whereas the Epicycle and the Excentrique doe cut one another, doth wander through the plane of the Epicycle in such  
fort,

fort, as the one halfe of the Epicicle looking vp towards the North limit, declineth from the plane of the Excentrique towards the South. And the other halfe approaching nigher to the South limit, declineth from the Excentrique towards the North, as you may plainly perceiue by the former seventh figure, in which, that halfe of the Epicicle which looketh towards the North limit, marked with G, is the vpper halfe of the Epicicle, marked with the letters L H I: but when that halfe commeth vnto the Node descendent, marked with O, then it is called the Occidentall halfe, marked with the letters K L H: and when it is come to the South limit, marked with N, then it is called the inferior or nether halfe, marked with the letters I K L: But when that halfe arriueth to the Node ascendent, marked with M, then it is called the Orientall halfe, and is marked with the letters H I K. And the other halfe of the Epicicle declining from the plane of the Excentrique towards the North pole, looketh towards the South limit.

5. Fifthly, when the Planet is in the vpper halfe of the Epicicle, in which the Auge is, then he alwaies walketh betwixt the Eclipticke and the Excentrique: but when he is in the nether halfe, he goeth cleane without them both.

6. Sixtly, the diameter of the Auge being in the vpper halfe of the Epicicle, and out of the Nodes, declineth towards the Eclipticke, and being againe in the nether halfe, departeth from the Eclipticke towards that part whereunto the Excentrique declineth. Hereof it must needs follow, that the Planet whilest he is in the Orientall halfe, encreaseth his latitude, and in the Occidentall halfe deminisheth the same, but yet so, as his latitude



rude from the Node ascendent to the Node descendent, is alwaies Northerly, and from thence to the node ascendent it is alwaies Southerly.

*What be the greatest latitudes of the three Planets, as well in the North and South limit, as also in the North and South true Auges of the Epicycle?*

**A**Ccording to the tables of *Alphonsus*, when the Planet is in the North limit of the Excentrique, and also in the North true Auge of the Epicycle, then the greatest North latitude for Saturne is 2 degrees,  $\frac{1}{2}$ . for Jupiter 1 degree,  $\frac{1}{2}$ . and for Mars only  $\frac{1}{2}$ . And when the Planet is in the North limit of the Excentrique, & therewith in the North opposit Auge of the Epicycle, then the greatest North latitude for Saturne is 3 degrees,  $\frac{1}{2}$ . for Jupiter 2 degrees,  $\frac{1}{2}$ . and for Mars 4 degrees,  $\frac{1}{2}$ . But when the Planet is in the South limit of the Excentrique, and therewith in the South true Auge of the Epicycle, then the greatest South latitude for Saturne is two degrees,  $\frac{1}{2}$ . for Jupiter 1 degree,  $\frac{1}{4}$ . and for Mars only  $\frac{1}{2}$ . And if the Planet be in the South limit of the Excentrique, and therewith in the South opposit Auge of the Epicycle, then the greatest South latitude for Saturne is 3 degrees,  $\frac{1}{2}$ . for Jupiter 2 degrees,  $\frac{1}{8}$ . and for Mars 7 degrees,  $\frac{1}{10}$ . But betwixt *Alphonsus* his tables and the Prutenicall tables there is some difference, for the Prutenicall tables when the Planet is in the North Auge of the Epicycle, doe allow for the greatest North latitude of Saturne 2 degrees,  $\frac{1}{2}$ . for Jupiter 1 degree,  $\frac{1}{6}$ . and for Mars  $\frac{1}{2}$ . Againe, the Planet being in the North opposit Auge, they allow for the greatest North latitude of Saturne

turne 3 degrees,  $\frac{1}{2}$ . for Iupiter 2 degrees,  $\frac{1}{4}$ . and for Mars 4 degrees,  $\frac{1}{10}$ . and when the Planet is in the South true Auge of the Epicicle, they allow for the greatest South latitude of Saturne 2 degrees,  $\frac{1}{2}$ . for Iupiter 1 degree,  $\frac{1}{2}$ . and for Mars  $\frac{1}{4}$ . Again, when the Planet is in the South opposit Auge of the Epicicle, they allow for the greatest South latitude of Saturne 3 degrees,  $\frac{1}{2}$ . for Iupiter 2 degrees,  $\frac{1}{2}$ . and for Mars 6 degrees,  $\frac{1}{10}$ .

*The seventh Conclusion.*

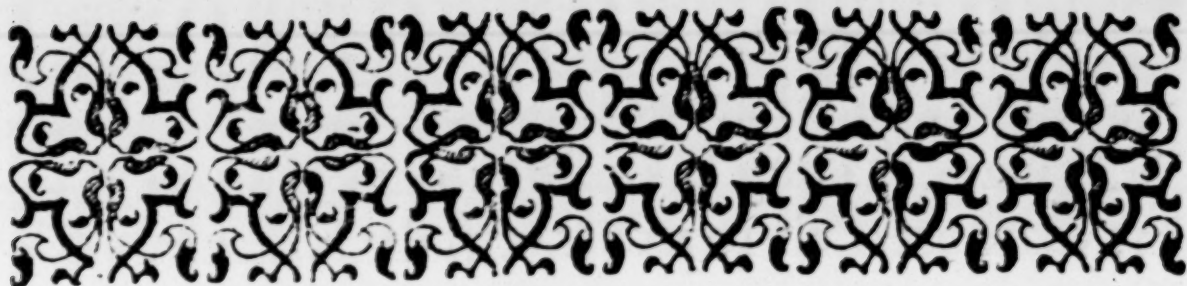
**T**He diameter of the meane longitudes, and the diameter of the mutuall sections of the Epicicle and of the Excentrique, are alwaies in a manner equally distant to the diameter of the section of the Excentrique and of the Eclipticke, and thereby are equally distant also, in a manner to the Eclipticke it selfe. I say here in a manner, because that neither of the foresaid diameters being out of the limits or nodes, are justly equally distant from the Eclipticke, yet the difference is so small, as it is scant sensible, and therefore may be taken for one simple latitude, whereby the plane of the Epicicle, which in the Nodes is vnited to the Eclipticke, maketh the diameter, which is paralell to the line drawne through both the limits to decline vpon that diameter, which is a paralell to a right line drawne through both the Nodes, which the former seventh figure plainly sheweth: for when the Epicicle is either in M or in O, then the diameter of Inclination, marked with I L, is paralell to the line G F N, drawne through the two limits, and also through the centre F. But when the Epicicle is in G or N, then the diameter H K, looking vpward, is all one with the line G F N.

P ij

Again,



Againe, the Epicicle being in M and O, such declination is made vpon the ouerthwart diameter H K, which then is all one with the line drawne through the Nodes, marked with the letters O F M : but the Epicicle being in G or N, the same Inclination is made vpon the diameter I L, being paralell to the line O F M, so as in the meane places that are betwixt the limits and the Nodes, the enclining diameter looketh vward, and that diameter whereupon the Inclination is made, is alwayes transverse or ouerthwart. From hence the Astronomers doe calculate the latitudes of these three Planets, hauing regard onely to the position or placing of the Epicicles in the two limits, and by the proportionall minutes doe find out the equacion in euery other place or position, according as the said Position is more or lesse distant from the limits, or from the Eclipticke.



## *g* The Theorique of Venus.



He first Intention belonging to the Theorique of Venus, sheweth of how many orbes her Theorique consisteth, which are in number five, like vnto the Theorique of any of the three vpper Planets, before described, *viz.* the Excentrique, the two deferents of the Auges of the said Excentrique, the Epicicle, and the circle Equant; all which are necessarily vsed in this Theorique for the selfesame causes that are before declared in the first Intention belonging to the Theorique of the three vpper Planets, the first figure whereof by certaine letters plainly sheweth all the orbes belonging to this Theorique of Venus. Wherefore I wish you to resort thereunto, thinking it superfluous here againe to describe the same.

*The second Intention, shewing the diuers motions of the orbes wherof this Theorique consisteth, and vpon what centres, axletrees, and poles, they make their reuolutions, and in what time.*

*First shew how and in what manner the Excentrique of Venus is moued?*

**T**He Excentrique of Venus is mooued according to the succession of the signes, vpon his owne axletree  
P iij and



and poles, together with the poles of the two deferents of the Auges, and that equally about the centre of the circle Equant, making his full reuolution in the space of one yeare precisely together with the Excentrique of the Sunne.

*Where is the centre of the circle Equant placed, about which the Excentrique of Venus maketh his regular motion?*

**T**He centre of the circle Equant is placed in the line of the Auge beyond the centre of the Excentrique, being double so much distant from the centre of the world, as is the excentricitie of the Excentrique: & hereof it followeth, that the orbe excentrique doth carry the Epicycle more slowly about the point Auge, and more swiftly about the opposit Auge.

*How are the deferents of the Auges moued?*

**T**hey are moued according to the succession of the signes vpon their owne poles, about the centre of the world, as well beyond as on this side of the vagarant poles of the Eclipticke, by vertue of the eighth sphere, making their reuolution according to the account of *Alphonfus*, in 49000 yeares. And by this motion the Auge and opposit Auge of the Excentrique are by little and little put forward. And this vnstabilenesse of the poles of the two deferents causeth also the poles of the Excentrique to be vnstable and to wander on either side.

*Ptolomey* in his time found the Auge of Venus to be in the 25 degree of Taurus, and he thought that it crept  
for-

forward one degree in a 100 yeares, euen as the sphere of the fixed starres doth. But according to the later obseruations of *Copernicus*, the Auge of Venus in these dayes is found to be in the 16 degree and  $\frac{1}{10}$  of  $\pi$ .

Now as touching the mouing of the Auge of Venus, *Copernicus* agreeth with the auncient Astronomers, affirming, that it turneth about together with the fixed starres, alwaies keeping a firme and fixed place vnder the Orbe of the fixed starres. But as touching the time of the whole reuolution of the said Auge, *Ptolomey* affirmeth it to be 36000 yeares, and the followers of *Alphonsus* do make the same to be 49000 yeares.

*Copernicus* affirmeth that time of reuolution to bee no more but 25810 Ægyptian yeares. Neither is the error of the *Alphonsines* here to be kept silent, who doe not let to affirme, That the Auge of Venus and that of the Sunne, are continually joyned together, and that either of them in *Ptolomeyes* time, was in the 13 degree,  $\frac{1}{10}$  of  $\pi$ , which is cleane contrarie to his owne obseruation. By which their false calculation, the Auge of Venus and of the Sunne should be in these dayes in the 2 degree of Cancer, whereas indeed it is in the 16 degree,  $\frac{1}{10}$  of  $\pi$ .

*How and in what manner is the Epicicle of Venus moued?*

It is mooued in the vpper part thereof according to the succession of the signes, and in the nether part contrarie to the succession of the signes, vpon his owne moouable axletree, standing slopewise vpon the plane of his Excentrique, and is equally mooued from his meane Auge, making his whole reuolution almost  
in



in 19 moneths. And his daily mouing is,  $\overset{i}{3} \overset{ii}{6} \overset{iii}{5} \overset{iiii}{9} \overset{v}{28} \overset{vi}{0} \overset{vii}{7}$ .  
 so as he maketh one period in 583 dayes, that is to say, in  
 one yeare, 7 moneths, 8 daies, 22 houres,  $\overset{i}{10} \overset{ii}{38} \overset{iii}{31}$ .

*How is the meane Auge of the Epicycle described?*

**E**VEN as it is in the Epicycles of the three vpper Planets, by helpe of a right line, being drawne from the centre of the Equant through the centre of the Epicycle to the circumference thereof. And you haue to note, that all the conclusions belonging to the mouing of this Epicycle, are like and all one with those that are gathered out of the moouing of the Epicycles of the three vpper Planets, before set downe.

*What harmonie is betwixt the moouings of Venus, and of the Sunne?*

**T**HE periodical moouing of her Excentrique is like vnto that of the Excentrique of the Sun; with whose Excentrique, her Excentrique is exactly carried about. And the *Alphonsines* doe not let to affirme, That both their Auges are continually joyned together, contrarie to the obseruation of *Ptolomey*, and of all others, as hath been said before.

*What conclusions doe follow of this harmonie?*

**T**Hese here following: for first the Sunne and Venus in their meane mouing are alwayes joined together: and hereof it followeth, that they both must needs haue one selfe line of meane mouing, whereby their meane  
 mouing

mouing is bounded. And this line is a paralell as well to the right line which is drawne from the centre of the Sunne his Excentrique to the centre of his body, as also to that right line which is drawne from the centre of Venus her Equant to the centre of her Epicicle; whereby it appeareth, that Venus can stray no further from the Sunne, than the greatnesse of her Epicicle will suffer her. And hereto may be added, that the excentricitie of the Excentrique of the Sunne and that of the equant of Venus are like, for in *Ptolomeyes* time they were both like: And though that *Copernicus* found either of them in our time to be decreased, yet the equacions of their Excentriques cannot much differ, but be equall.

*Shew the dimension of the Orbes belonging to the sphere of Venus.*

**A**S the semidiameter of the Excentrique of Venus containeth 60 parts or degrees, euen so of the like degrees *Ptolomey* sayth, that the excentricitie of the said Excentrique containeth 1 degree, and  $\frac{1}{2}$ . and that the excentricitie of her Equant containeth 2 degrees, and  $\frac{1}{2}$ . like to that of the Sunne: and that the semidiameter of her Epicicle containeth 43 degrees, and  $\frac{1}{2}$ . and hereof it appeareth, that the least altitude of Venus from the earth is 15 degrees,  $\frac{1}{2}$ . and her greatest altitude is 104 degrees,  $\frac{1}{2}$ . But *Copernicus* sayth, That in these daies the excentricitie of her Equant is no more but 2 degrees,  $\frac{1}{6}$ . so as by that means the excentricitie of the Excentrique should be no more but  $\frac{1}{2}$ . like to that of the Sunne, being also deminished as he saith, in his particular propositions.

Q

The



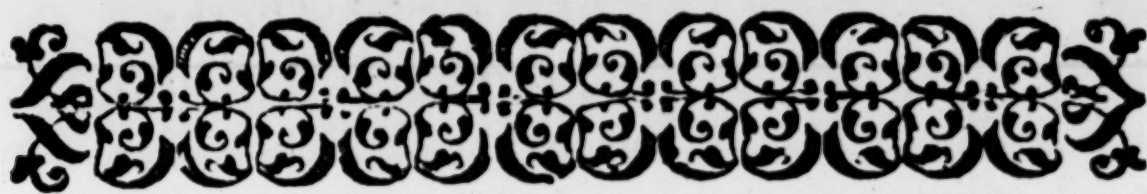
*The third Intention, describing all such points, lines, arches, semicircles, and such like things as are needfull to be knowne for the calculating of the movings of Venus.*

**I**N this Theorique all such things are described in like manner as they be in the Theorique of the three vpper Planets, and therefore resort to the third Intention of their Theorique before set downe: but yet the line of the meane mouing of Venus is all one with that of the Sun, and both their meane movings are also like and the selfe same. And the greatest equacion of Venus her Excentrique, is according to the tables of *Alphonfus* 2 degrees  $\frac{1}{10}$ . and according to the Prutenicall tables it is no more but 2 degrees,  $\frac{1}{7}$ . And the greatest equacion of her argument (the centre of her Epicycle being in the Auge of the said Excentrique) is according to the tables of *Alphonfus* 44 degrees,  $\frac{1}{44}$ . but according to the Prutenicall tables it is 45 degrees,  $\frac{1}{10}$ .  $\frac{11}{30}$ . But when the centre of her Epicycle is in the opposit Auge of her Excentrique, then the greatest equacion of her argument according to *Alphonfus* his tables, is 47 degrees,  $\frac{1}{11}$ . and according to the Prutenicall tables 46 degrees,  $\frac{1}{11}$ .  $\frac{11}{30}$ .

*The fourth Intention, shewing the mouing of Venus according to latitude.*

**S**ith the varieties of Venus her latitudes are like in all respects vnto those of Mercurie, I leaue to speak thereof, vntill I come to treat of the motion of Mercurie according to his latitudes, and so I end with Venus.

¶ The



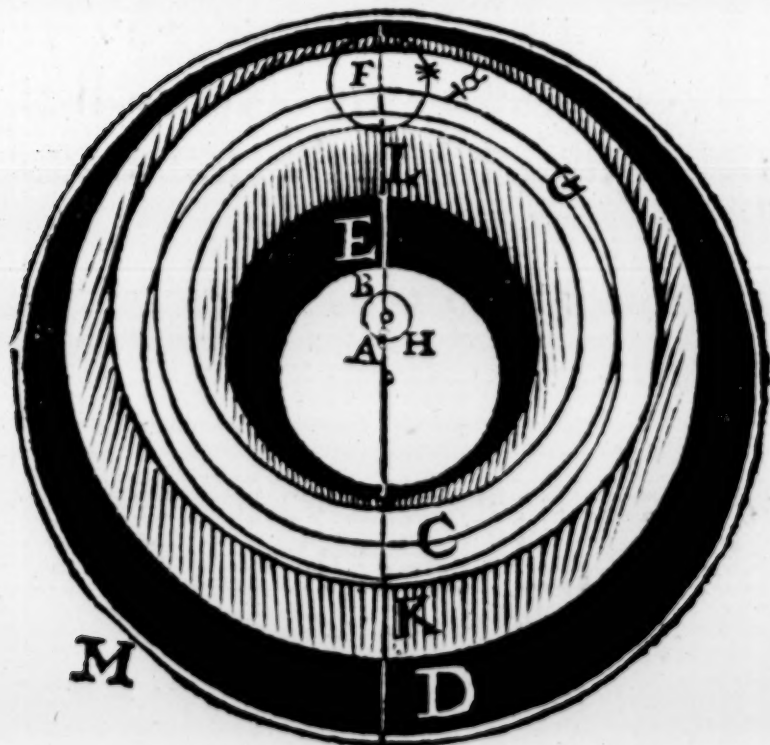
## ¶ The Theorique of Mercurie.

*The first Intention belonging to the Theorique of Mercurie, shewing of what and how many orbes his Theorique consisteth.*



His Theorique consisteth of seven Orbes, that is, the Excentrique, the two deferents, carrying the Auge of the Equant, the excentor of the Excentrique, the Epicicle, the circle Equant, and the circle of the Nodes, as this figure sheweth.

¶ The first figure belonging to the Theorique of Mercurie.



Qij

In





**I**N which figure the letter A signifieth the centre of the world, and B the centie of the Excentrique, and C signifieth the Orbe Excentrique, which is a white orbe: and the two blacke orbes, marked with the letters D E, are the two deferents of the Auge of the Excentrique, and the letter F signifieth the centre of the Epicicle, in whose circumference the starre of Mercurie is turned about: and the letter G signifieth the circle Equant, whose centre is marked with the letter H, in the line of the Auge, a little aboue the centre A. And B H is the diameter of the little circle, which little circle is almost in the midst of the foresaid first figure, and the centre of that little circle is marked with the letter I, in the circumference of which little circle is carried about the centre of the Excentrique, marked with B. And the letter I is also the centre of the Orbe called *Excentrus excentri*, which indeed are two orbes going close together, marked with the letters L and K, and are shaddowed with little lines; and these two orbes doe containe within the compasse thereof the whole orbe Excentrique, which carrieth the Epicicle of Mercurie. And the outermost circle of all, marked with M, signifieth here the deferent of the nodes.

*Wherefore is the excentor of the Excentrique added to the sphere of Mercurie?*

**B**Ecause hee hath a peculiar varietie in his moouing, not common to the other Planets, for his equacions in departing from the Sunne, are found to be least but once, and to be greatest twice, as though he ascended but once to the Auge, and descended twice to the opposite

posit Auge: which things are salued by adding this orbe to his Theorique. And all the rest of the orbes are placed in this Theorique for the selfesame causes that are before declared.

*How and in what manner is the Excentrique of Mercurie mooued?*

**I**T is moued in like manner as is the Excentrique of Venus, according to the succession of the signes, vpon his owne axletree and proper poles, vagarant together with the poles of the deferents of the Auges, and that equally about the centre of the circle Equant, making one period in the space of one yeare precisely together with the Excentrique of the Sunne.

*Where is the centre of Mercurie his circle Equant to bee found, about the which his Excentrique goeth regularly?*

**T**He centre of Mercurie his Equant is in the line of the mean Auge, in the very middest betwixt the centre of the world and the centre of that orbe which is called the excentor of the Excentrique: for it occupieth the lowest part of the little circle, described by the centre of the Excentrique, and this centre of the Equant is marked in the former figure with the letter H.

*How many Auges do belong to the Excentrique of Mercury?*

**T**Wo, that is, the true Auge and the mean Auge. The true Auge is in the Excentrique, described by a right line drawne from the centre of the world through the



centre of the Excentrique : and this Auge by reason that the centre of the Excentrique goeth round about the little circle, is not stable, nor keepeth alwaies one place. But the meane Auge belonging as well to the Excentrique as also to the circle Equant, is described by a right line, drawne from the centre of the world through the centre of the Excentrique, and also through the centre of the Equant, both which centres are in one selfe line. And this meane Auge is the rule of the true Auge, because it remaineth fixed vnder the deferents of the Auges. And therefore these two deferents of the Auges are also said to carry about this Auge of the Equant.

*What is to be gathered hereof?*

**T**Hat the Excentrique of Mercurie, like as that of the Moone, is swifter in his vpper part towards the Auge, than in his nether part : for there the centre of the Equant approacheth nigher vnto the opposit Auge, than to the Auge.

*How are the deferents moued, that doe carry the Auge of the Equant, otherwise called the meane Auge?*

**T**hey are moued according to the succession of the signes, about the centre of the world, vpon their proper poles, both on this side and beyond the vagrant poles of the Eclipticke, by vertue of the eighth heauen, making their reuolution together with that heauen according to the *Alphonsynes* doctrine, in 49000. yeares: and by this mouing the Auge and opposit Auge  
of

of the Equant are put forward . And this instabilitie of the poles of the deferents, doe also make the poles of eyther Excentrique to wander on both sides of the Eclipticke.

*Ptolomey* in his time found the Auge of Mercuries Equant to be in the 10 degree of Libra, thinking that according to the obseruations of the former times, the said Auge, together with the sphere of the fixed starres, went but one degree in a hundred yeares. But according to *Copernicus* his obseruations, the said Auge is found to be in the beginning of Sagittarius: Whereby he gathereth, That the said Auge vnder the sphere of the fixed starres, maketh one degree in 63 yeares (so as the motion of that Auge is equall:) and according to these obseruations, it maketh his whole reuolution vnder the Orbe of the fixed starres, in 22405 Ægyptian yeares, but vnder the Zodiake it maketh his period in 11995 Ægyptian yeares, which lacketh but five yeares of 12000 Ægyptian yeares. And the tables of *Alphonfus* cleane contrarie to the manifold obseruations of *Ptolomey* doe make the Auge of Mercurie to haue been in his time in the 12 degree  $\frac{1}{10}$ . of Libra, according to which account, it ought to be in these dayes in the first degree and  $\frac{1}{10}$ . of Scorpio.

*How is the excentor of the Excentrique moued?*

**I**T is equally mooued contrarie to the succession of the signes, about his owne centre, which is also the centre of the little circle, and vpon his owne axeltree and proper poles vagrant, together with the poles  
of



of the two deferents that doe carry the Auge of the Equant: and it maketh his period in the space of one yeare, in which time the Excentrique also goeth once about the line of the Auge. And you haue to note, that the excentor of the Excentrique, as the Excentrique it selfe, do both returne in like time to the line of the Auge, that is to say, the excentor contrarie to the succession of the signes, and the Excentrique according to the succession of the signes, both I say in the space of 365 dayes, 6 houres,  $\frac{1}{3}$ .  $\frac{ii}{8}$ . and  $\frac{iii}{5}$ .

*What conclusions doe follow of the mouing of this Orbe?*

**D**iuerse, but specially these three here following.

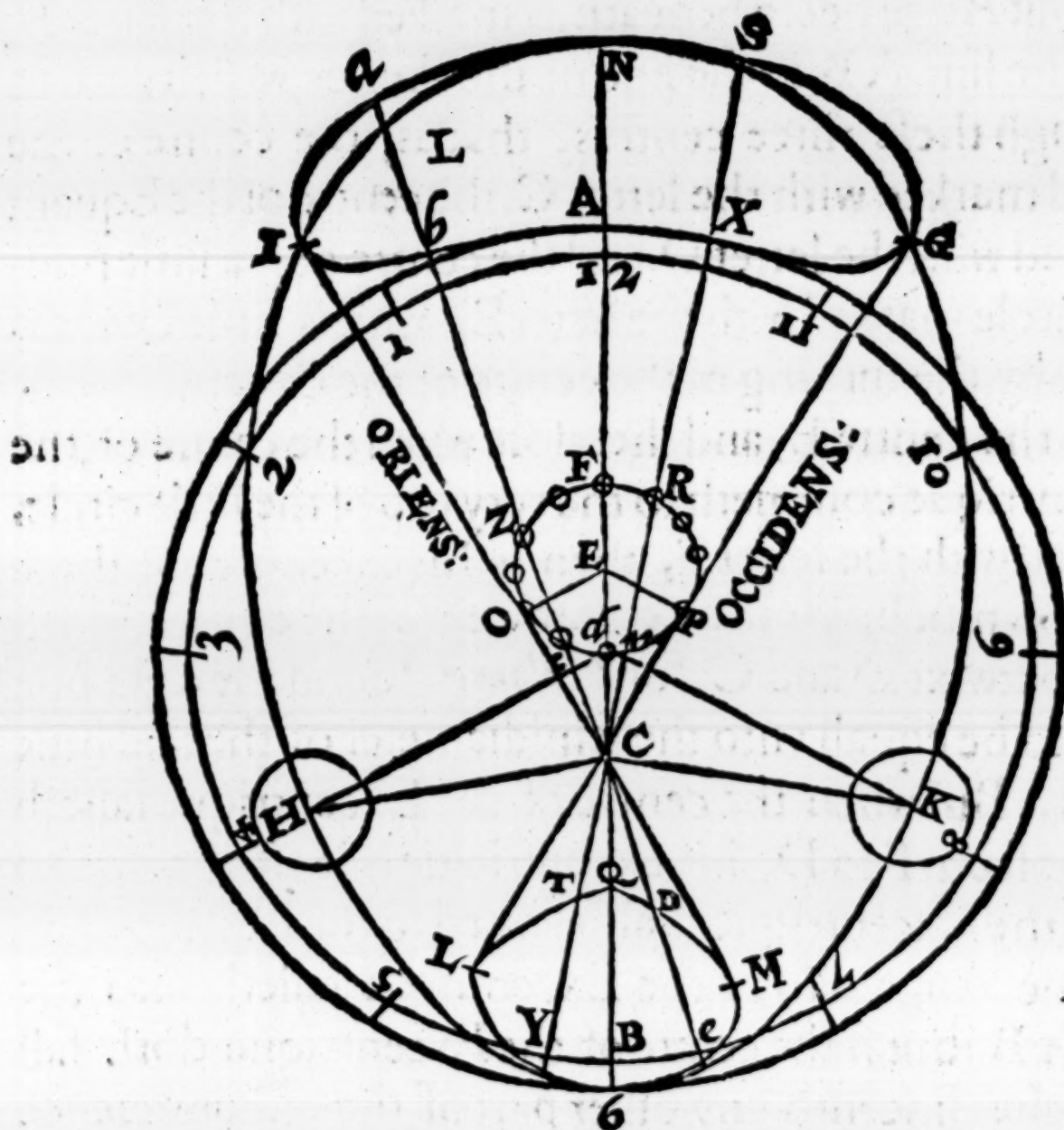
1. First, that the centre of the Excentrique is carried about the circumference of the little circle.

2. Secondly, that the excentricitie of the Excentrique is sometime changed, for many times it is threefold so much as is the excentricitie of the Equant, and specially when the centre of the Excentrique is in the top of the little circle; but when the centre of the Excentrique is in the lowest part of the little circle, then the excentricitie of the Excentrick is equal to the excentricitie of the equant.

3. Thirdly, that the Auge and opposit Auge of the Excentrique is turned about the Auge & opposit Auge of the Equant, as well contrarie as also according to the succession of the signes, and yet doth neuer exceed his bounds, that is to say, the twelfth part of the Zodiacke. Now for the better vnderstanding of this which hath ben and shall be said hereafter, all those that doe write of the Theoriques doe set downe this figure here following.

*The*

¶ The second figure belonging to the Theorique of Mercurie.



**H**is figure as you see consisteth of diuers circles, some greater, some lesser; and of diuers right lines, some longer, some shorter: and of the circular lines there is one that hath a shape Ovale, like to an egge; and there be two others, the one like to a halfe Moone, and the other like to an Oyster shell or Cockle shell: all which things, whereto they serue and what they signifie, shall be here declared by helpe of the letters

R

therein



therein contained: for the double, round, and greatest circle being deuised into twelue equall parts, marked with Arithmetical figures, signifieth the circle Equant, whose Auge is marked aboue with the letter A, and his opposit Auge being beneath, is marked with the letter B, and the line A B is the line of the Auges, which passeth through these three centres, that is, the centre of the world marked with the letter C, the centre of the Equant marked with the letter D, and the centre of the little middle circle marked with the letter E, which little circle is made by the turning of the centre of the Excentrique about the centre E, and therefore when the centre of the Excentrique commeth to the very top of the little circle, marked with the letter F, then is his excentricitie three times as much as is the excentricitie of the equant, which lieth betwixt D and C, for *Ptolomey* found the right line D C to be equall vnto the semidiameter of the said little circle. But when the centre of the Excentrique falleth downe from F to D, his excentricitie is least of all, and there the Excentrique is also vnited to the Equant it self, and the Auge also of the Excentrique falleth into the line A B: but if the centre of the Excentrique doth fall from that line into any other part of the circumference of the said little circle, then his Auge doth wander either into the West part going contrarie to the succession of the signes, or els into the East part, going according to the succession of the signes; as suppose the centre of the Excentrique to be in the point marked with P in the little middle circle on the right hand, then his Auge will be in G, and his opposit Auge in L: and if his centre be in O, then his Auge shall be in I, and his opposit Auge in M: and if his centre be in R, then his Auge will be in S, and his



his opposit Auge in T: but if his centre be in V, then his Auge will be in X, and his opposit Auge in Y: so likewise if his centre be in Z, his Auge will be in *a*, and his opposit Auge in *d*: and if his centre be in C, then his Auge will be in B, and his opposit Auge in E. And the outermost bounds of the wanderings of the Auges are the two letters G and I: and the bounds of the wanderings of the opposit Auges are the two letters L and M, which bounds doe limit these foure angles, that is, G C A, I C A, L C B, and M C B. To euery one of which angles in the circular concentrique dooth answere one whole signe of the Zodiacke, which *Mestelyn* dooth proue by certaine propositions of *Euclides* first booke, which for breuitie I here omit. You haue also to note, that the foresaid Auge describeth the vpper circle, made in a manner like a halfe Moone, marked with the letters N S G X A B I *a*: and the opposit Auge describeth the nether circle, made like an Oyster shell, marked with the letters Q T L Y B *e* M *d*, and vpon the long Ovale circle are placed two little circles, of each hand one, signifying the Epicicle of Mercurie, whose centres are marked with the letters K and H: for the centre of his Epicicle describeth the said Ovale figure, but not altogether like vnto the Ovale figure of the Moon, as shall be shewed hereafter. In the meane time you haue to note, that when the centre of the Excentrique is in the top of the little circle, marked with F, then the Epicicle is furthest distant from the earth, because he is then in the Auge. But when the Epicicle is come downe in the Ovale figure vnto the point H, and the centre of the Excentrique is also come downe in the little circle vnto the point P, hauing made a third part of that circle, euen as



the Epicicle hath made a third part of the Equant, then the Epicicle is nighest vnto the earth. But when the centre of the Excentrique is come downe to the point D, and the Epicicle is come to the opposit Auge, marked with B, then he is more distant from the earth, than when he was in the point H, the demonstration whereof I here omit: and the Epicicle beeing come to the opposit Auge, hath then passed through the whole excentor of the Excentrique, and hath made one period, and doth the like in the other halfe: whereby you may gather first, that the centre of the Epicicle in making one period dooth passe twice through the excentor of the Excentrique: secondly, that the said centre of the Epicicle in making one reuolution, is but once in the Auge of the Excentrique, at which time he is most distant from the earth. But being in the very opposit Auge, he is not so nigh vnto the earth, as when he is in the other two points before mentioned, each of which points is distant 120 degrees from the Auge of the Equant, and in those points is nearest to the earth. Thirdly, that the centre of the Epicicle, by these manifold motions, describeth the said Ovale figure, which notwithstanding is not like in many respects vnto the Ovale figure of the Moone; how and wherefore, we come now to shew.

*A comparison shewing in what things the Moone and Mercurie by their motions do agree or differ, in describing their Ovale figures: and first, they agree in these things following.*

**F**Or looke how much the Excentrique of either Planet dooth proceed according to the succession of the signes,

signes, that is to say, the Excentrique of the Moone from the line of the mean mouing of the Sun, and the Excentrique of Mercurie from the line of the meane Auge; so much doe the orbes of vnequall thickenesse reuert contrarie to the succession of the signes, that is to say, the two deferents carrying the Auge of the Moone, and the excentor of the Excentrique of Mercurie doe make like circuits as well to the foresaid lines, as to their opposit parts. Secondly, the centre of either of their Excentriques by the going backward of the said orbes, describeth about the centres of the same orbes a little circle. Thirdly, whilest the Excentrique maketh one period to the foresaid lines, the centre of the Epicicle of either Planet goeth twice about the foresaid orbes. Wherefore it followeth of necessitie, that the Epicicle in euery reuolution is twice nighest, and twice furthest off from the centre of the little circle: and by this meanes, the Epicicle of either Planet in making one period describeth with his centre the figure *Ouale*. Thus much touching their likenesse or agreement in describing the figure *Ouale* of either Planet. Now we will shew you wherein they disagree in making the figure *Ouale*. The centre of the little circle in the sphere of the Moone, is also the centre of the world; but in the sphere of Mercurie al that little circle is excentricall, because that in Mercurie it is described by an orbe which is excentricall, and in the sphere of the Moone it is described by those orbs, which in some respect are concentricall. Wherefore the Auge of the Moone dooth wander equally throughout the whole Zodiacke: but the Auge of Mercurie is turned and wrythed on each side of his meane Auge: and by his turning and wandering, now on this side, and now on



that side, both the Auge and also the opposit Auge doe each of them make a figure that wrieth in and out, and that which the Auge maketh, is marked in the former figure with the letters N S G X A *b* I *a*, almost like to a halfe Moone; and that which the opposit Auge maketh, is marked with these letters, Q T L Y B *e* M *d*, much like to an Oyster shell, as hath beene said before. Whereof it followeth, that the Auge of the Moone is onely moued contrarie to the succession of the signes. But the Auges of Mercurie doth sometime proceed by a reciprocke mouing according to the succession of the signes. Moreouer, the excentricitie of the Moone in a whole period is neuer changed, but abideth alwaies one and the same: but the excentricitie of Mercurie is continually changed. Againe, the Moone in euery her reuolution falleth twice into the Auge, and twice into the opposit Auge, by meanes whereof she is twice furthest from the earth, and twice nighest to the same; and the limits of those distances is a iust quarter of a circle one from another, which is 90 degrees. But Mercurie falleth neither into the Auge nor opposit Auge but once only, and he is furthest distant from the earth when he is in the Auge. But he is nighest to the earth twice (not when he is in the opposit Auge) but in two places, each of them being distant on either side from the Auge the third part of a circle, which is 120 degrees. Finally, the Epicicle of the Moone describeth a figure, more like to a figure Lenticular, than to a figure Ouale. And the Epicicle of Mercurie describeth a figure more Ouale than otherwise, the cause whereof is, for that the centre of the Moones Equant (about which her Excentrique maketh his regular motion) is also the centre of the little circle.

circle. But the centre of Mercuries Equant is resident in the lowest part of the said little circle, notwithstanding each figure is commonly called an Ovale figure.

*How and in what maner is the Epicicle of Mercurie moued?*

**T**He Epicicle of Mercurie in the vpper part is moued according to the succession of the signes, and in the nether part contrarie to the succession of the signes, about his owne moouable axletree, standing slopewise vpon the plane of the Excentrique. And it is equally moued from the meane Auge, making his reuolution almost in 4 months, and his daily moouing containeth 3 degrees,  $\overset{i}{6} \cdot \overset{ii}{24} \cdot \overset{iii}{14} \cdot \overset{iiii}{5} \cdot \overset{v}{36}$ . so as it maketh one period in 115 dayes, 21 houres,  $\overset{i}{3} \cdot \overset{ii}{20} \cdot \overset{iii}{4}$ .

*How is the meane Auge of this Epicicle described?*

**I**T is described by a right line drawn from the centre of the Equant, and passing through the centre of the Epicicle, euen to the circumference thereof.

*What conclusions are to be gathered hereof?*

**F**irst, that the Epicicle of Mercurie, contrarie to that which happeneth in the three vpper Planets, and also in Venus, is slower of gate in the vpper part of the Excentrique, & quicker of gate in the lower part of the Excentrique, because the centre of the Equant in this Theorique of Mercurie approcheth nigher to the opposite Auge, but in the other Planets last named, the centre of their Equant approcheth nigher to the Auge.

Secondly,



Secondly, when the centre of the Epicicle is in the line of the Auges, then both the meane and true Auge of the Epicicle, and also the point of concauitie are all three vnited together in one selfe line, yea, the meane Auge and also the point of concauitie are again vnited, when the centre of the Epicicle is in any of the two points of next approach to the earth, marked in the former second figure with the letters H K: and from thence about those points of next approach towards the Auge of the Excentrique, the meane Auge of the Epicicle is alwayes in the middest betwixt the true Auge and the point of concauitie. But beneath the foresaid points of next approach towards the opposit Auge of the Excentrique, the point of concauitie is in the middest of the meane and true Auge of the Epicicle: the demonstration whereof for breuitie sake I doe here omit.

*What harmonie or agreement is there betwixt Mercurie and the Sunne?*

**M**ercurie as well as Venus, in the periodically mouing of their Excentrique, dooth follow the Sunne: for the reuolution of Mercurie agreeth most exactly with the Excentrique of the Sunne. And hereto you may also adde, that the excentor of the Excentrique of Mercurie, maketh his reuolution together with the Excentrique of the Sunne, not simply, but in hauing respect to the mean Auge of Mercurie, or of the Equant: yea, and moreover according to the late obseruations and speciall conclusions touching the orbes of the Sunne (whereof we haue spoken before in the Theorique of the Sunne) Mercurie touching so much as appertaineth to his mouing  
 accor-

according to longitude, agreeth with the Theorique of the Sunne, both in number and in like disposition or placing of the orbes, and also in the qualitie of the mouing of the said orbes. For according to *Copernicus*, there is in both Theoriques an excentor of the Excentrique, going contrarie to the succession of the signes, whereby the meane Auge is on both sides most distant from the true Auge, and causeth the excentricitie to be mutable.

*What conclusions doe follow of this harmonie?*

**T**Hese here following : for first you haue to note, that the Sunne and Mercurie, and also Venus, are alwayes joyned together in their meane moouing: and as they haue all three one selfe meane moouing, so they must needs haue also one selfe line of their meane moouing. And hereof it followeth, that neither Mercurie nor Venus can depart from the Sunne any further than the bignesse of their Epicile will suffer them. Moreover, look how much the Sun proceedeth forward from the mean Auge of Mercurie: so much the centre of Mercuries Excentrique goeth backward in the little circle.

*How are the Orbes belonging to the sphere of Mercurie to be measured?*

**O**F such like parts as the semidiameter of the Excentrique, marked with the letters D A, or with P H, in the former figure, containeth 60 parts, the excentricitie of the Equant, marked in the said figure with the letters C D, containeth according to *Ptolomey* three parts, and the greatest excentricitie of the Excentrique, marked

S

ked



ked with the letters C F, containeth 9 such parts. And the line of the Auge, marked with C N, containeth 69 such parts or degrees. And the line of the opposit Auge marked with C Q, (such as it is then) containeth 51 degrees. But when the centre of the Epicicle is in the very opposit Auge it selfe, marked with D, then the line of the said opposit Auge, marked with C B, containeth 57 parts. But the line of the nighest approach, marked on the left side of the former figure with C H, and on the right side with C K, is said to containe 55 degrees, and  $\frac{1}{3}$ . and so the semidiameter of the Epicicle containeth 22 degrees and  $\frac{1}{10}$ . Hereof it followeth, that the greatest distance of Mercurie being placed in the Auge of his Excentrique and of his Epicicle, containeth 91 degrees and  $\frac{1}{10}$ . and if his excentricitie did continue alwayes fixed and vnmoouable, the altitude of Mercurie being in the opposit Auges of those orbes, should be 28 degrees, and  $\frac{1}{10}$ . And though that Mercurie himselfe with his bodie doe neuer descend so farre, for such causes as are before declared, yet it is necessarie that this capacitie be attributed to his orbe. And when Mercurie is in any of the points of nighest approach, then his least altitude is 33 degrees and  $\frac{1}{4}$ .

*The third Intention, shewing what points, lines, and arches are meet to be knowne in the Theorique of Mercurie.*

**I**N all these things Mercurie agreeth with Venus and with the three vpper Planets, which being alreadie set downe in those Theoriques, need not here againe to be rehearsed, & therefore resort to the third Intention, as

as well of the three vpper Planets, as to that of Venus. In the tables as well of *Ptolomey*, as in those of *Alphonfus* and of their followers, the equacions of the arguments are counted at that place of the Excentrique, in which the distance of the centre of the Epicicle from the earth is equall vnto the semidiameter of the Excentrique. And to these equacions may be added the excesse of the longer longitude, and also the excesse of the nigher longitude, not that when the Planet is in the very opposite Auge, but when he is in any of the two points of nighest approach. To these equacions also may be referred the proportionall minutes both longer and nigher.

The equacions of the Parallax or of the Epicicle which are set downe in the Prutenicall tables, do appertaine to the Auge of the Equant. But the excesse do belong to the points of next approach, marked in the second figure with the letters H K. What this word Parallax doth signifie, shall be declared hereafter. And you haue to vnderstand, that the greatest equacion of the centre containeth 3 degrees,  $1^{\circ} \frac{11}{30}$ . and that the greatest equacion of the argument, when the centre of the Epicicle is in the Auge of the Excentrique, containeth 19 degrees,  $1^{\circ} \frac{11}{6}$ . But when the Epicicle is in any of the 2 points of next approach, then it containeth 23 degrees,  $1^{\circ} \frac{11}{40}$ .

*The fourth Intention, shewing the latitudes, as well of Venus as of Mercurie, and wherein they do agree or disagree.*

IN qualitie these two Planets are most like, for looke in what maner the Excentrique of Venus doth decline towards the Ecliptick, or her Epicicle to the Excentrique;



in like manner dooth the Excentrique and the Epicicle of Mercurie make their declination, but yet with this difference, that looke in what sort those two circles in the Theorique of Venus do decline towards the North, in like sort the said two circles in the Theorique of Mercurie doe decline towards the South.

*How manifold is the latitude of these two Planets?*

**T**Hreecfold, whereof one dependeth vpon the moouable obliquitie or slopenesse of the Excentrique, and the other two latitudes doe depend of the inclinations of the Epicicles, which inclinations are also twofold and mouable, whereof the one in Greeke is called *Engclysis*, and the other *Loxosis*, as shall be declared hereafter.

*What manner of latitude is that which the Excentrique of either Planet causeth?*

**W**E haue said before, that the poles of the deferents of the Auges doe wander both beyond and also on this side of the poles of the Eclipticke, and therefore the plane of the Excentrique hath obliquitie or slopenesse, and yet not fixed as in the other vpper Planets but mouable. And as well the mutuall section, as the swaying of the planes of the Excentrique and of the Eclipticke is made vpon the diameter of the world, standing with right angles vpon the line of the Auge, and therefore the diameter which gouerneth this declination, is the line of the Auge and of his opposit Auge. And by this meanes it falleth out, that the Auge and opposit Auge, or rather the each halfe of the plane of the whole Theorique

orique doth sway from the Eclipticke, now towards the North, and now towards the South, but the nodes of such swaying are alwaies distant from the Auge one whole quarter of the Zodiacke: and this mooving of latitude is commonly called the declination of the Excentrique.

*What proportion doth the swaying of the declination of the Excentrique, as well of Mercurie as of Venus obserue in the making of their periods?*

**T**His here following: for when the centre of the Epicycle is either in the Node ascendent or descendent, all the whole plane of the Excentrique doth fall into the Eclipticke; for though the centre of Mercurie his Epicycle doth neuer ascend to the North, nor the centre of the Epicycle of Venus to the South, yet we may call the one node ascendent, and the other descendent, as well for the likenesse or proportion that is betwixt those two Planets & the other Planets, as also for that the one node is in the ascendent halfe of the Excentrique towards the Auge, & the other node is in the descendent halfe of the Excentrique towards the opposit Auge. But if the centre of the Epicycle be in the vpper halfe aboue the diameter of the section or swaying towards the Auge, then the Auge, or rather the whole vpper half of the Excentrique doth decline from the Eclipticke, that is to say, in Venus towards the North, and in Mercurie towards the South. But if the centre of the Epicycle be in the nether halfe, then the Auge of Venus declineth towards the South, and the opposit Auge towards the North: but in Mercurie it is cleane contrarie, and the greatest declination



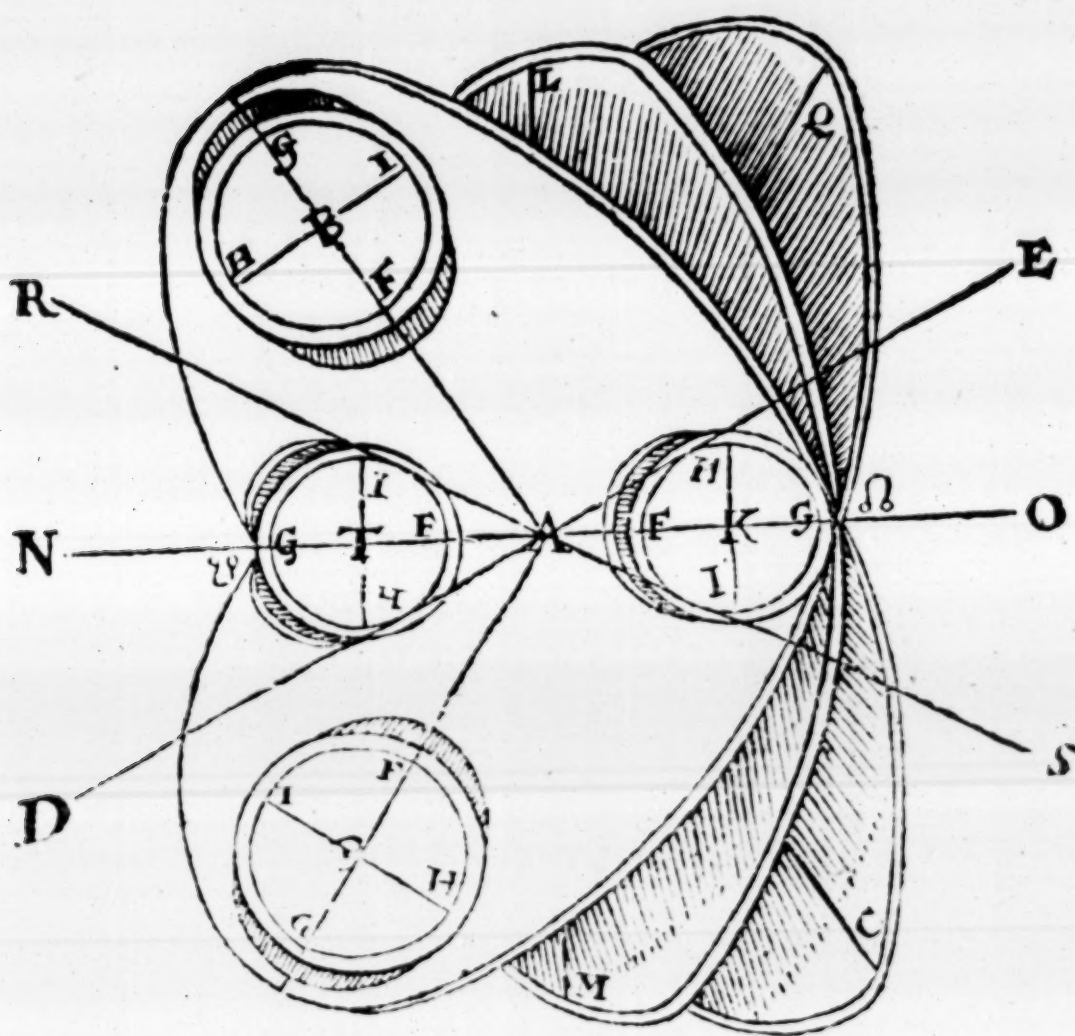
is when the centre of the Epicicle is either in the Auge or opposit Auge of the Excentrique.

*What conclusions may be gathered hereof?*

**F**irst, that the Auges are not alwaies found to be in the North nor in the South, as it chanceth in the three vpper Planets, but sometime in the one place, and sometime in the other.

Secondly, that the centre of Venus her Epicicle doth neuer arriue vnto the South, nor the centre of Mercuries Epicicle to the North: for this swaying is of such manner, as that halfe of the Excentrique, into which the Epicicle at any time entreth, doth by and by begin to decline into the said North part for Venus, and into the South part for Mercurie: and this Inclination of the Excentriques, causeth that the North latitudes of Venus be alwaies greater than her South latitudes; but in Mercurie it is cleane contrarie. And you haue to note, that the greatest angle or section of the Excentrique and Eclipticke, is for Venus,  $10^{\circ}$ . and for Mercurie,  $4^{\circ}$ . But for the better vnderstanding, as well of this that hath been said before, as of that which is to be said hereafter touching the foresaid latitudes, it shall be needfull to set down this figure here following.

¶ The third figure shewing the latitudes of the said two Planets.



**H**is figure, made somewhat like to a Butterflie, with her wings spread open, containeth three severall planes of orbes, cutting one another in the diameter of the world, which passeth through the centre of the world, marked here with A: which three planes doe represent no more but one onely plane, that is, the Excentrique of Venus or of Mercurie, to shew the diverse positions or placings of the said Excentrique, caused by the latitude of their inclination. And ye have to vnderstand, that the middlemost of these three planes or orbes, marked with the letters L K M T, and containing therein



therein foure Epicles, doth signifie, that the Excentrique being in either of the two points K or T, is vnited to the Eclipticke: but the other two planes, whereof the first hauing the line of the Auge drawne through the limits of the greatest declination, marked with the letters B C, and the second plane hauing a line marked with Q P, dooth signifie the declination of the Excentrique from the Epicle. Moreouer, in this figure the two planes B C, and Q P, hard by the mutuall section which is nigh vnto K and T, are cut off, not for that such orbes are to be cut off indeed; but that by this means the Epicles being in K or T, might be the better scene in the middlemost plane, marked with the letters L K M T. You see also, that in this figure the circumference of euery one of the foure Epicles is marked with these four letters, G H F I, but yet placed in diuerse order, according to the diuers mouing of the Epicle. And you haue to note, that when the centre of any of those Epicles is in the Node ascendent, marked with K, then the plane of the Excentrique, whose diameter by passing through the Auge L, and the opposit Auge M, is the line L A M, wholly vnited to the Eclipticke, hauing no declination at all, whereby the axletree of the said plane, marked with N O, hangeth perpendicularly vpon the plane of the Eclipticke. But when the centre of the Epicle ascendeth from the Node K towards the Auge of the Excentrique, marked with B, then the vpper part of the Excentrique dooth by and by decline from the Eclipticke towards the North for Venus, and towards the South for Mercurie; as when the centre of the Epicle is in the Auge B, for then the diameter B A C, or rather the whole vpper halfe of the Excentrique is found to be on  
this

this side of the Eclipticke, and the inferiour part of the Excentrique to be beyond the Eclipticke, and the axletree of the Excentrique is then the line DE. But when the centre of the Epicicle is come downe to the Node descendent, marked with T, then the plane of the Excentrique is vnited again to the Eclipticke, and the right line LA M is againe the diameter of the Auge. But when the Epicicle is once passed the Node descendent, marked with T, then the vpper part of the Excentrique which was before on this side of the Eclipticke, beginneth now to decline beyond the Eclipticke, wherefore the lower part of the Excentrique beginneth now to haue the same declination which the vpper part had before, that is to say, towards the North for Venus, and towards the South for Mercurie. And therefore the centre of the Epicicle being in the opposit Auge, marked with P, the position of the Excentrique is the line PAQ, and the axletree thereof, is the line RS. It appeareth therefore, when the centre of the Epicicle is in any of the Nodes, either K or T, that then the Excentrique is vnited to the Eclipticke. But if the centre of the Epicicle be out of those Nodes, then as well towards the Auge B, as towards the opposit Auge P, the Excentrique hath the like latitude as before, that is, North latitude for Venus, and South latitude for Mercurie. And therefore the centre of the Epicicle doth not goe beyond the Eclipticke, either towards C or Q.

*What manner of latitudes haue the Epicicles, as well of Venus as of Mercurie?*

**T**He planes of their Epicicles, whose axletrees we haue said before to be oblique or sloping to the Excentriques



centriques vpon the two diameters, that is to say, vpon the diameter of the Auges, and vpon the diameter of the meane longitudes are enclined and swaied on both sides of their Excentriques, and yet proportionally answerable to the periods of their Excentriques.

*How is the first diameter, passing through the Auges, declined?*

**T**He diameter of the Auges declineth on both hands from the plane of the Excentrique, in such sort as followeth : for when the centre of the Epicicle is in any of the limits, that is to say, either in the Auge or opposite Auge of the Excentrique, marked in the former figure with B P, then the diameter of the Auges haue no declination at all, because it falleth just into the plane of the Excentrique; but the declination thereof is greatest, when the centre of the Epicicle is in any of the two Nodes, yet with such difference, as the inclination of this diameter, or rather of the one halfe of the plane of the Epicicle being made in the descending halfe of the Excentrique, is for Venus Northward, and for Mercurie Southward: but in the ascending halfe of the Excentrique, the halfe of this diameter for Venus is Southward, and for Mercurie Northward. And this declination is made vpon the diameter of the meane longitudes, which the former figure dooth plainly shew : for the Epicicle being in B or P, which are the two limits, the declination of the diameter of the Auges is nothing at all. But the centre of the Epicicle being in T, which is the Node descendent, the vpper part of this diameter, marked with T G, declineth from the plane

plane of the Excentrique Northward for Venus, and Southward for Mercurie: but the lower halfe, marked with T F, enclineth contrariwise, that is to say, Southward for Venus, and Northward for Mercurie. And because that the declination is greatest when the Epicycle is in any of the Nodes, then the aforesaid diameter beginneth againe to approach vnto the plane of the Excentrique, and in the limit P is vnited againe to the plane of the Excentrique, and from thence the vpper part of the said diameter declineth beyond the plane of the Excentrique to the other side, and the inferior part to this side. Wherefore the Auge of the Epicycle, marked with G, being in the point K, which before was for Venus Northward, is now Southward, and for Mercurie cleane contrarie. The greatest angle of this Inclination of the plane of the Epicycle vnto the Excentrique, is demonstrated by *Ptolomey* and *Copernicus*, to be for Venus two degrees, and  $\frac{1}{2}$ . and for Mercurie 6 degrees, and  $\frac{1}{2}$ . To these from the Auge of the Epicycle to the centre of the world, doe agree for Venus one degree, and  $\frac{1}{2}$ . and for Mercurie one degree, and  $\frac{1}{4}$ . But from the opposit Auge of the Epicycle to the centre of the world, it is for Venus 6 degrees, and  $\frac{1}{2}$ . and for Mercurie 4 degrees, and  $\frac{1}{2}$ . Hitherto of the first manner of the declination of the Epicycles from their Excentriques, called in Latine *Inclinatio*, or *Deviatio*, in Greeke *Engclisis*.



*Now shew in what manner the other diameter, passing through the meane longitudes of the Epicicle, maketh his declination?*

**T**HIS kind of declination of the Epicicle, is commonly called the reflection, in Greeke *Loxosis*, because it maketh the diameter of the meane longitudes to reflect on both sides from the plane of the Excentrique in such manner as followeth: for while the centre of the Epicicle is in any of the Nodes, which is distant a just quarter of the Zodiacke from the Auge or opposit Auge, then the reflection of this diameter is nothing at all, because then it falleth wholly into the plane of the Excentrique; but such reflection is greatest, when the centre of the Epicicle is in any of the limits, or in the Auge or opposit Auge. And yet with such difference, as the reflection of the halfe of this diameter, called the Orientall halfe of the Epicicle, may be in the vpper halfe of the Excentrique, Northward for Venus, and Southward for Mercurie. But in the lower halfe of the Excentrique, the said Orientall halfe of the Epicicle reflecteth for Venus towards the South, and for Mercurie towards the North. And this reflection is made vpon the diameter of the Auges, all which things the former figure dooth plainly shew. For when the centre of the Epicicle is in K or T, which be the two Nodes, then the diameter of the mean longitudes, marked with H I, hath no reflection at all, but lieth whole vpon the plane of the Excentrique, as you may see in the Node ascendent, marked with K: but in the vpper part of the Excentrique towards the Auge, when the centre of the Epicicle is in the Auge B, then  
the

the Orientall halfe of the diameter H I, marked in the highest Epicicle of this figure with the letters H B, or els the Orientall halfe of the said highest Epicicle, marked with the letters G H F, doth reflect from the plane of the Excentrique for Venus Northward, and for Mercurie Southward. But the Occidentall halfe of the said diameter, marked with B I, or that halfe of the Epicicle marked with F I G, doth reflect cleane contrarie, that is to say, for Venus towards the South, and for Mercurie towards the North. And when the reflection is greatest, then this diameter approcheth the Eclipticke, and falleth into the same in the point T, that is to say, in the Node descendent. And departing from thence downward towards the limit P, the said halfe of the diameter reflecteth on the other side beyond the Eclipticke, and then the Occidentall halfe succeedeth, which as when it was in the vpper part of the Excentrique, was for Venus South, and for Mercurie North: so now by going from T to P, and so to K, it is made for Venus Northward, and for Mercurie Southward. And the greatest angle of the reflection of this diameter vnto the Excentrique, is demonstrated to be for Venus 3 degrees,  $\frac{1}{10}$ . & for Mercurie 7 degrees: and to these doe agree at the centre of the world the latitudes for Venus to be 2 degrees,  $\frac{1}{10}$ . and as much for Mercurie. Notwithstanding, because Mercurie hath a greater excentricitie, this angle in the Auge of the Excentrique, hath to the centre of the world two degrees,  $\frac{11}{15}$ . and in the opposite Auge of the said Excentrique, it hath 2 degrees,  $\frac{11}{45}$ .



*What conclusions are to be gathered of the inclinations and reflections of the Epicycles?*

1. **T**Hese here following: First, the plane of the Epicycle is neuer vnited with the plane of the Excentrique or of the Eclipticke, by reason of the continuall inclinations of the one or of the other diameter. And therefore the axletree of the Epicycle is neuer perpendicular to any of those planes.

2. Secondly, the declinations of the diameter of the Auges, and of the meane longitudes of the Epicycle of these two Planets, that is to say, of Venus and Mercurie, are contrarie to the declinations of the three vpper Planets, for there the declinations of the diameters of the Auges are greatest in the limits, & nothing in the nodes, but the declinations of the said diameters in these two Planets are greatest in the nodes, and nothing in the limits. Againe, the reflections in the three vpper Planets are greatest in the nodes, and nothing in the limits, whereas in these two Planets the reflections are greatest in the limits, and nothing in the nodes.

3. Thirdly, the planes of the Excentriques and Epicycles of these two Planets doe cut one another in diuers diameters: for in the nodes such section is made in the diameter of the meane longitudes, but in the limits the same section is made in the diameter of the Auges; and in the meane places such section chanceth sometime in one place, and sometime in another, betwixt the said diameters: but the said section in the three vpper Planets, obserueth contrarie order, as hath been said before.

4. Fourthly, the line of the mutuall section of the Epicycle

cicle and of the Excentrique doth wander through the plane of the Epicicle in such sort, as the one halfe of the said plane departeth from the plane of the Excentrique for Venus towards the North, and for Mercurie towards the South: so the other halfe of the said plane declineth cleane contrarie, that is to say, for Venus towards the South, and for Mercurie towards the North: but in the three vpper Planets such line of mutuall section obserueth a contrarie order. By these conclusions it is manifest, that the latitude of Mercurie and Venus hath three variations, the first by reason of the moouable obliquitie of the Excentrique: the second by reason of the moouable declinations of the Epicicle: and the third by reason of the moouable reflections of the said Epicicle. All which things you may the more easily perceiue by the former figure, for the Epicicle being in the Node ascendent, marked with K, the diameter of the meane longitudes, marked with H I, is in the very plane of the Excentrique: but the diameter of the Auges of the said Epicicle, marked with F G, hath then greatest declination, so as the whole nether halfe of the said Epicicle, marked with the letters H F I, looking towards the Node descendent, is for Venus Northward, and for Mercurie Southward. And the vpper halfe of the said Epicicle, marked with the letters I G H, being partly hidden from our sight, by reason that it is vnder the Excentrique, is for Venus Southerly, and for Mercurie Northerly: and the diameter of the section, marked with H I, is a paralell to the line of the Auge of the Excentrique, which line is marked with these letters, L A M, whereof L signifieth the Auge, and M the opposit Auge of the  
Excen-



Excentrique, and A the centre of the world : so in the other Node, marked with T, the selfsame diameter H I is in the meane longitudes, but there the vpper halfe of the Epicicle, marked with the letters I G H, looking towards the same part as before, is then for Venus towards the North, and for Mercurie towards the South. But the lower halfe of the Epicicle, marked with the letters H F I, (whereof some part is now againe hidden and couered as it were with the plane of the Excentrique) is for Venus towards the South, and for Mercurie towards the North. The like and the same dooth chance when the centre of the Epicicle is either in the Auge B, or the opposit Auge P ; for in those places the diameters of the Auges, marked with F G, hauing no declination, the Epicicles are diuided, and the diameters H I haue their greatest reflection : and yet after the same manner as before, that is, when the East halfe is in B, and the West halfe in P, which letters doe signifie as well the two limits, that is, B the North limit, and P the South limit, as the two Auges; for here againe the one halfe of the Epicicle is wholly to be seene, in which whilest it goeth towards the Node descendent, Venus is Northward, and Mercurie Southward. But the other halfe of the Epicicle, (which the plane of the Excentrique dooth partly hide and couer) dooth reflect or turne backward on the the other side from the Excentrique. And euen so it fareth in like manner in all the meane places that are betwixt the limits and the nodes. And here endeth the first booke of the Theoriques.



## The second Booke or Part, treating of the Passions or Accidents of the Planets.



Having sufficiently spoken of the three  
 severall latitudes, belonging as well to  
 Venus as to Mercurie, I mind here to  
 make an end of the first part of the The-  
 oriques; wherein have been plainly  
 declared all the diverse motions of the  
 Planets, as well according to their longitude as latitude:  
 and so now to proceed to the second part, wherein wee  
 have to treat of the passions, qualities, or accidents of  
 the Planets; of which, though *Purbachius* maketh five  
 kinds, counting their motions according to latitude to  
 be one of those five: yet me thinkes that *Mestelyn* hath  
 more reason to make but foure generall kinds, sith the  
 latitude of every Planet, that hath latitude, is rather a  
 principall part of his motion than a passion: for all their  
 motions are either according to longitude, or to lati-  
 tude, and therefore minding herein to follow *Mestelyn*, I  
 will set downe but foure kinds of passions, as he dooth,  
 which doe grow of foure severall comparisons. First, by  
 comparing the mooving of the Epicycle of any Planet  
 together with the mooving of his Excentrique. Second-  
 ly, by comparing the mooving of the Planets one to  
 ano-



another. Thirdly, by comparing their moouings to the Sunne. And fourthly, by comparing their moouings or rather places to the centre of the world and to the globe of the earth, euery one whereof containeth certaine speciall kinds of passions or accidents, hereafter declared.

*What speciall accidents doe belong to the first generall kind, consisting of the comparison of the mouing of the Epicycle to the mouing of his Excentrique?*

**B**Y this passion the Planets are said to be sometime direct, sometime retrograde, and sometime stationarie; which three accidents doe belong onely vnto the five Planets, the Sunne and Moone not beeing reckoned. Moreouer, they are said to be sometime swift, sometime flow, and sometime in a meane. Sometime also they are said to be either encreased or deminished in number, and sometime to be ascendent, and sometime descendent.

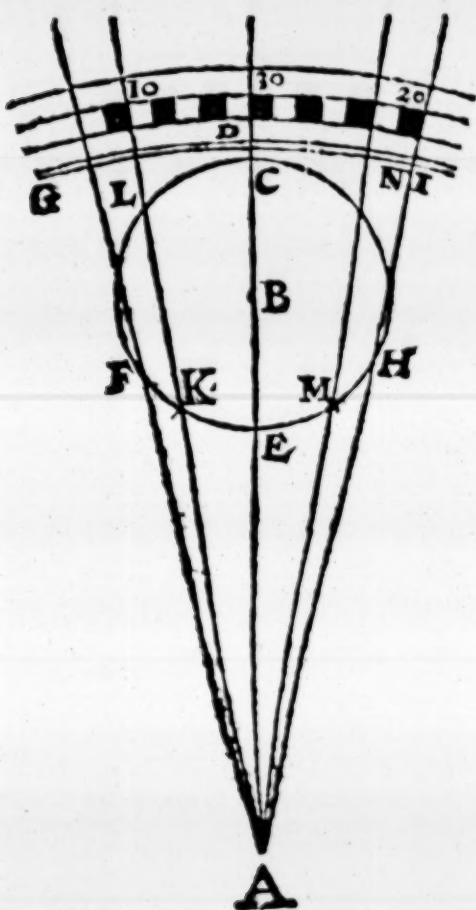
*When is any Planet said to be direct, retrograde, or stationarie?*

**I**T is said to be direct, when the line of the true mouing of the Planet, drawne from the centre of the world through the midde bodie of the Planet, proceedeth forward according to the succession of the signes, following the line of the true mouing of the centre of his Epicycle, which goeth alwaies according to the succession of the signes. And it is said to be retrograde, when the line of the true mouing of the Planet goeth more backward, contrarie to the succession of the signes, than the line of the true moouing of the centre of the Epicycle procee-

proceedeth forward according to the succession of the signes. And it is said to be stationarie, when both these lines are drawne to the Zodiacke with an equall moouing into diuerse parts of heauen, so as the line of the Planets true moouing maketh as great an arch of the Zodiacke in going backward contrarie to the succession of the signes, as the line of the true mouing of the centre of the Epicycle maketh, in proceeding forward according to the succession of the signes, for then the Planet for a while seemeth to stand still, and not to be mooued from his place, and thereof is said to be stationarie, like to any of the fixed starres. And you haue to vnderstand, that these diuersities of motions vnder the Zodiacke proceedeth of the mouing of the Epicycle, which in his vpper part carrieth the Planet according to the succession of the signes, and in his nether part carrieth the same contrarie to the succession of the signes, called his retrogradation. In which inferior or nether part of the Epicycle are the two points of station. But for the better vnderstanding of that which hath been said touching the direction, retrogradation, and station of any Planet, it shall be needfull to set downe this figure here following, together with the description thereof, the signification of whose parts the letters doe shew as you may see in the page next following.



¶ The first figure of the second Booke.



**I**N this figure the letter A standing at the nether end of the right lines, signifieth the centre of the world, from whence all the said right lines are drawne to the Zodiacke: and B signifieth the centre of the Epicicle: & the middle right line A B passing through the true Auge of the Epicicle, marked with C, dooth shew the true place of the said Auge vnder the Zodiacke, marked with the letter D: and the letter E sheweth the true opposit Auge of the Epicicle: and the highest arch aboue, containing certaine degrees of diuision, signifieth a portion of the Zodiacke: and the two outermost lines, A F G, and A H I, be lines of contingence, touching the Epicicle in the two points, marked with H and F: and the two inner right lines, marked with the letters A N, and A L, drawne from the

the centre A through the two points of station, marked with K and M, do shew in the Zodiacke the retrogradation, marked with the letters L N: and the two points H F doe deuide the Epicycle into two parts or halfe, whereof the one is called the vpper halfe, marked with the letters H C F, and the other the nether halfe, marked with the letters F E H. And as the point F sheweth the Orientall or East part, so H sheweth the Occidentall or West part: and euery one of the five Planets in the vpper halfe of the Epicycle, marked with H C F, is said to goe from H to F, according to the succession of the signes, describing the arch of the Zodiacke, marked with I D G, which is called his direction or progression: but in the lower halfe, marked with F E H, the Planet is said to goe contrarie to the succession of the signes, called his retrogradation: and when he is in any of the two points, marked with K M, then he is said to be stationarie; whereof the point K is the point of the first station, whereas the Planet beginneth first to be retrograde, and M is the point of the second station, whereas the Planet endeth his retrogradation, and beginneth his progression: which two points are alwaies beneath the two Touch-points F H, towards the opposit Auge of the Epicycle, marked with E, from which the two points of station are alwaies equally distant, and also from the true Auge of the Epicycle. And the letters C F K doe shew the arch of the first station, which arch is otherwise called the first station in the second signification; and C F K M doe shew the arch of the second station, otherwise called the second station in the second signification: and the letters M H C F K, doe shew the arch of progression, and K M doe shew the arch of retrogradation.



But you haue to note, that though the two points of station are alwaies equally distant as well from the opposit Auge, as from the Auge of the Epicicle, yet such distance is not alwaies of like qualitie, neither is the arch of their progression, nor the arch of their retrogradation alwaies of one bignesse, but do alter and that for four causes: First, for that the Epicicle through the moouing of his Excentrique is sometime nigher and sometime further off from the centre of the earth: for the nigher that the epicicle is to the earth, the more are the stationall points distant from the true opposit Auge of the Epicicle in all the five Planets, sauing in Mercurie. The second cause may be the diuerse magnitude of the Epicicle, being compared to his Excentrick, for the stationall points of a greater Epicicle do approach nigher vnto the opposit Auge, than the stationall points of a lesser Epicicle doe. The third cause is the periodical flownesse or swiftnesse of the Epicicle, being compared to the periodical mouing of his Excentrique, for the slower reuolution of the Epicicle maketh the stationall points to be nigher to the opposit Auge of the Epicicle, and therby as well the arch of progression as of retrogradation doe encrease and decrease. Fourthly, the diuersities of their excentricities may cause the stationall points to alter in their distances from the opposit Auge of the Epicicle.

*Wherefore is the Moone and Sunne exempted from these passions?*

**T**He Sunne hath no Epicicle, and though the Moon hath an Epicicle, yet she is neither said to be stationarie nor retrograde, by meanes of the swiftnesse of the  
centre

centre of her Epicycle, which maketh euery day a greater arch of the Zodiacke, according to the succession of the signes, than she can goe backward, because her Epicycle is both small and slow in her gate. And though Saturne hath a very small Epicycle, yet the swiftnes thereof doth supplie that want, and thereby he is both stationarie and retrograde, and so are the other foure Planets, *viz.* Iupiter, Mars, Venus, and Mercurie.

*When are the Planets said to be swift, slow, or in a meane?*

**T**hey are said to be swift, when their true moouing is quicker, according to the succession of the signes, than their meane moouing is: and they are said to be slow, when their true moouing is slower (according to the succession of the signes) than their meane moouing is: and they are said to be in a meane, when their true moouing (according to the succession of the signes) is equall vnto their meane moouing.

*When are Planets said to be encreased or deminished in number?*

**T**hey be encreased when the line of the true moouing goeth (according to the succession of the signes) before the line of their meane moouing. And they are said to be deminished in number, when the line of their true moouing dooth follow after the line of their meane moouing.

*When*



*When is any Planet said to be ascendent or descendent?*

**H**E is said to be ascendent, whilest he ascendeth from the opposit Auge of his Epicycle to the Auge thereof: and he is said to be descendent, whilest he descendeth in the other halfe of the Epicycle from the Auge to the opposit Auge of his said Epicycle.

*The second generall kind of passions, rising of the comparison made by comparing the moving of euery Planet one to another, comprehending the five Aspects of the Planets, which be these here following.*



That is to say, their Coniunction, their Sextile aspect, their Quadrile aspect, their Trine aspect, and their Opposition: whose characters are here set down, together with the definition of euery such Aspect.

1. The Coniunction, marked thus  $\phi$ . is when two Planets are both in one selfe signe, and in one selfe degree, which aspect in Greeke is called *Synodos*.

2. The Sextile aspect, marked thus  $\ast$ , is when two Planets are distant one from another by a sixt part of the Zodiacke, that is to say, by two whole signes, or 60 degrees, which aspect is called in Greeke *Exagonos*.

3. The Quadrile aspect, marked thus  $\square$ , is when two Planets are distant the one from the other three whole signes, or 90 degrees of the Zodiacke, and is called in Greeke *Tetragonos*.

4. The Trine aspect, marked thus  $\triangle$ , is when two Planets are distant the one from the other by foure whole signes or 120 degrees of the Zodiacke, and is called in Greeke *Trigonos*.

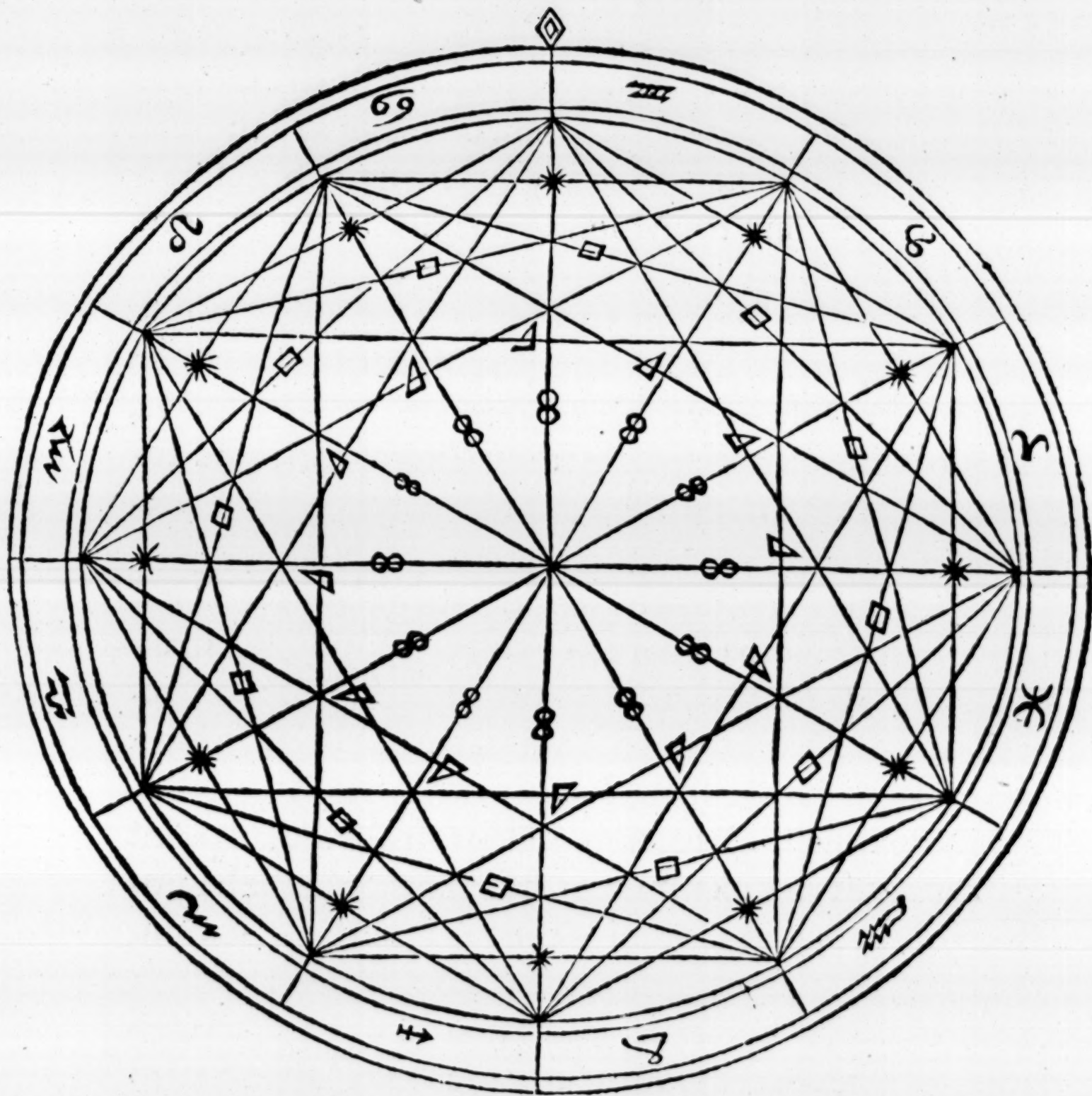
5. The

5. The Opposition, marked thus 8, is when two Planets are right opposit the one to the other, and are distant the one from the other by six whole signes or 180 degrees of the Zodiacke, and is called in Greeke *Diametros*, that is to say, a diametrall aspect, as when one is right against another in a right line. But you haue to vnderstand, that *Ptolomey* comprehendeth as well the Opposition as Conjunction of any two Planets, but especially of the Sunne and Moone, vnder this Greeke name *Syzigias*.

And you haue to note, that three of these aspects, that is, the Sextile, Quadrile, and Trine aspect, are said to be double, because they looke two manner of waies, that is, towards the left hand, called the sinister aspect, and towards the right hand called the dexter aspect. The direction of the sinister aspect is according to the succession of the twelue signs, which succession beginneth at Aries, and so proceedeth forward to Taurus, Gemini, and Cancer, and so forth to the last point of Pisces. But the direction of the dexter aspect is contrarie to the succession of the signes, looking backward from Aries towards Pisces, Aquarius, Capricornus, and so forth to the last point of Taurus. As for example, if one Planet be in the beginning of Aries, and another in the beginning of Gemini, those two Planets do looke one to another with a sinister Sextile aspect. But if the one Planet be in Aries, as before, and the other in Aquarius, then they looke one to another with a dexter Sextile aspect, as you may see by this figure following, which dooth plainely shew as well those aspects as all the other aspects before mentioned; it sheweth also with what aspect euery one of the twelue signes doe regard one another.



## ¶ The figure of Aspects.



**U**t you haue to vnderstand, that all the Planets  
doe not regard or behold one another with all  
the foresaid five aspects, for though the three vp-  
per Planets and the Moone may behold one another, or  
any

any of the rest with euery one of the said five Aspects, yet Venus and Mercurie cannot so doe, for Venus is neuer distant from the Sunne aboue 48 degrees, nor Mercurie aboue 29 degrees : and yet they may bee distant one from another by a Sextile aspect. And of the foresaid aspects, some are said to be meane, and some to be true, and specially their Conjunctions and Oppositions, whereof the Astronomers doe not make any great account, but onely of the Conjunctions and Oppositions belonging to the Sunne and Moone, which two Planets the Astronomers doe call in Latine *Luminaria*, that is to say, The two cheefe lights : the knowledge of whose meane and true Conjunctions and Oppositions, is necessarie, for the better vnderstanding of their Eclipses.

*When are their Coniunctions and Oppositions said to bee meane or true ?*

**T**hey are said to be meane, when the two lines of both their meane mouings doe meet in one selfe point of the Zodiacke, and doe make one selfe line. And they are said to bee true, when the two lines of their true moouings doe meet and make both one selfe line in one selfe degree of the Zodiacke, and their Oppositions are either meane or true, according as the said lines doe meet in the opposit points of the Zodiacke. And the true Conjunctions of the said two lights are said to bee true, sometime according to longitude onely, as when the foresaid true lines doe meet in one selfe point onely according to longitude : for the Moone doth oftentimes wander from the Eclipticke line, and



therefore though the line of her true moving doe meet with the line of the Sunnes true moving in one selfe point vnder the Zodiacke (the Moone hauing then latitude) yet that is according to longitude only: but if those two lines doe meet when the Moone hath no latitude, but is right vnder the Eclipticke line, then such Conjunction is both according to latitude, and also according to longitude, which is called a Corporall or Eclipticall Conjunction. And the like is to be said of their true Oppositions, when the said lines doe meet in like manner in the opposit points of the Zodiacke. Moreouer, you haue to note, that the true Conjunctions may differ from the meane Conjunctions by reason of time, for sometime the one may go before or after the other, and sometime meet both at one instant. They may meet both at one instant two manner of waies: First, when the Sunne or Moon are in the Auge or opposit Auge of their Excentriques, or when the one is in the Auge, and the other in the opposit Auge, for then the foresaid lines of their meane and true movings are all one. Secondly, they doe meet at one instant, when the equacions of their arguments are equall and of like qualitie, which is to bee knowne by the Prutenicall tables. But the true Conjunctions and Oppositions doe goe before the mean Conjunctions or Oppositions, when at the time of the mean Conjunction and Opposition the place of the Sunne is before the place of the Moone. And the true Conjunctions and Oppositions doe follow the meane, when at the time of the meane Conjunction and Opposition the place of the Moone is before the place of the Sunne. The like is to be said also touching their quarters, both meane and true. And you haue to note, that one whole period

period betwixt euery two Conjunctions or Oppositions of the Sunne and Moone dooth containe a Synodicall month, which is 29 daies and a halfe,

*The third generall kind of Passions, made by comparing of the mouings of all the six Planets, vnto the Sunne, containeth these three speciall kinds of Passions here following.*

1. **F**Or first they are said to be either encreased or decreased in light, or els to be combust, called in Greeke *Hyppaugi*, that is to say, hidden or couered with the beames of the Sun, so as they cannot yeeld their light.

2. Secondly, they are said to bee Orientall or Occidentall.

3. Thirdly, to haue diuerse kinds of rising and setting, like as the fixed starres haue, that is to say, they rise or set sometime *Cosmice*, sometime *Achronice*, and sometime *Helyace*; of which three Poeticall kinds of rising and setting, though I haue somewhat spoken before in my first booke of the Sphere, chap. 35. yet I wil declare the same here once againe more at the full, according to *Maginus*, who doth set them downe in such manner as hereafter followeth.

*Shew how and when these Passions doe chance?*

**T**He Planets are said to be encreased in light, when after that any of them hath been in Conjunction with the Sunne, either the Sunne departeth from that Planet, or the Planet departeth from the Sunne, vntill it be



at his furthest distance from the Sunne. And it is said to bee deminished in light, when after such furthest distance either the Planet approacheth to the Sunne, or the Sunne to the Planet. And it is said to be combust, when the Planet is hidden vnder the beames of the Sunne, so as it cannot yeeld his light, as is before said. Secondly, all starres are said to be Orientall or Matutine, when they rise before the Sunne; and they are said to bee Occidentall, when they goe downe after the Sunne; and yet with some difference as *Maginus* sayth: for the three vpper Planets (that is to say) Saturne, Iupiter, and Mars, are said to bee Orientall, Matutine, and to goe before the Sunne from the time of their being in Coniunction with the Sunne, vntill they come to be in Opposition to the Sunne, as well when they are scene, as not scene: and this happeneth whilest any of those three Planets descendeth from the Auge of his Epicycle through the meane longitudes vnto the opposit Auge of the said Epicycle: but the two inferior Planets, that is, Venus and Mercurie, are said to be Orientall, Matutine, and to goe before the Sun, when either of them ascendeth from the opposit Auge of his Epicycle vnto the Auge of the said Epicycle, which you may euidently see by the first figure of this second book. But as for the Moone, she is said to be Orientall, Matutine, and to goe before the Sunne, during the time of her wane or decrease. Againc, the three vpper Planets are said to be Occidentall, Vespertine, and to follow the Sunne from their being in Opposition with the Sunne, vntill they come againe to be in Coniunction with the Sunne; which chanceth whilest any of them is carried from the opposite Auge of the Epicycle through the  
meane



meane longitudes, vnto the Auge of the same Epicicle. But Venus and Mercurie are said to be Occidentall, Vespertine, and to follow the Sunne, whilest either of them descendeth from the Auge of their Epicicle vnto the opposit Auge of the same. But as for the Moone, shee is said to be Occidentall, Vespertine, and to follow the Sun all the time that she is in her encrease. Now you haue to vnderstand, that the rising and going downe of the fixed starres, as well Matutine as Vespertine, is twofold, that is, true and apparent. The Matutine rising is said to be true, when the starre riseth together with the Sunne in one selfe point of the Eclipticke, and at one selfe instant, at which time the star remaineth hidden vnder the beames of the Sunne: but such Matutine rising is said to be apparent, when the starre hauing been hidden a little before with the beames of the Sunne, doth get out from thence, so as in the morning it may bee scene, which chanceth when the Sunne goeth from the starre. Again, the Vespertine rising is said to be true, when the starre is right opposite in any part of the Eclipticke to the Sunne, at the time of his going downe, and is so much eleuated aboue the Horizon, as after the euening twilight it may be scene: but such Vespertine rising is said to be apparent, when the starre in the euening after Sun setting, dooth thine, and beginneth to appeare in the West. Now the Matutine going downe of any starre is said to be true, when the starre goeth downe at such time as the Sunneriseth, and is in the opposit point of the Eclipticke, to the Sunne. But the Matutine going downe is said to be apparent, when the starre at the rising of the Sunne (which a little before night haue been scene) is now hidden vnder the beames of the Sunne.

More-



Moreover, the Vespertine going downe of any starre is said to be true, when it goeth downe together with the Sunne at one selfe instant. And such Vespertine going downe is said to be apparent, when the starre at the going downe of the Sunne is hidden, which a little before might haue been seene, and so continueth hidden vntill the morning, vntill it may get from vnder the beames of the Sunne.

Out of this difference of rising and going downe of the Planets may be gathered these 6 rules here folowing.

1. First, that the three vpper Planets, the Moone, and also the fixed starres are subject to the true rising & setting as well Matutine as Vespertine; but neither the apparent rising Vespertine, nor the apparent setting Matutine doe belong to any of them, but only to the Moone, which notwithstanding suffereth neither the apparent rising Matutine, nor the apparent rising Vespertine.

2. Secondly, though Venus and Mercurie be subject to the apparent rising and setting, as well Matutine as Vespertine, yet they cannot haue the true Matutine setting, or the true Vespertine rising.

3. Thirdly, of all the fixed starres and of the three vpper Planets, their true rising and setting Matutine, are before their apparent rising and setting Matutine: but their true Vespertine rising and setting are after their apparent rising and setting.

4. Fourthly, in the two inferior Planets, that is, Venus and Mercurie, their apparent Matutine and Vespertine rising are after their true Matutine and Vespertine setting; but their apparent Matutine and Vespertine setting are before their true Matutine and Vespertine rising.

5. Fifthly, the apparent Matutine rising of the Moone  
doth

doth follow her true Matutine rising, and contrarie her apparent Matutine setting, doth go before her true Matutine setting.

6. Sixtly, it is meet that there bee some distance of space betwixt any starre and the Sunne, whereby they should either appeare to bee out of the beames of the Sunne, or else to be hidden vnder the Sunne.

And this distance is not of like quantitie in euery starre, but varieth according to the greatnesse or littenesse of the starre, for the greater and more lightsome that the starre is, the lesser time it staies vnder the beams of the Sunne. And the limits of the quantitie of distance that do belong to euery starre, as well to the fixed starres as to the Planets, are to be found in a great circle, passing both through the bodie of the Sunne, and also through the pole of the Horizon. For to euery limit the Astronomers doe appoint his proper arch of quantitie, called of them the arch of vision.

*Define what that arch is.*

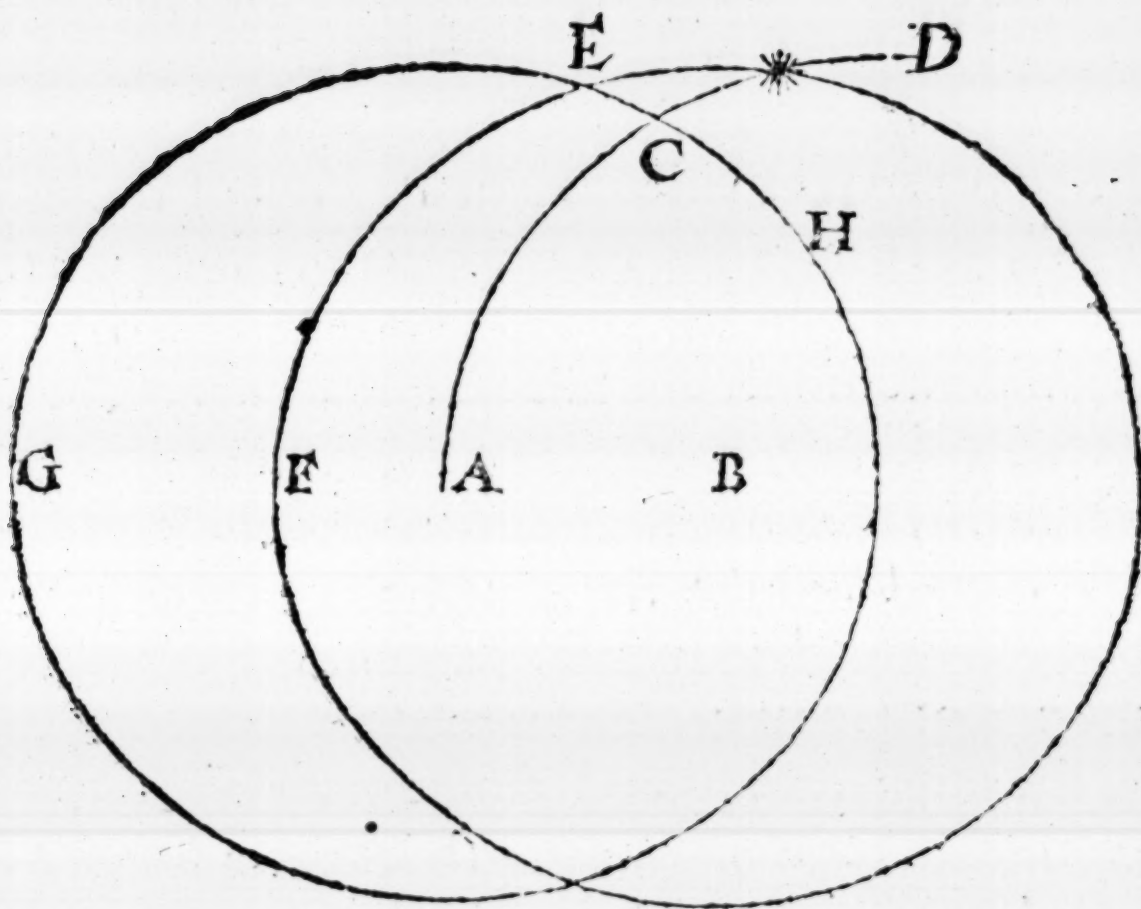
**T**He Arch of Vision, is that portion of the Verticall circle that is comprehended betwixt the Horizon and the Sunne, at such time as the starre first beginneth to appeare, or els ceaseth to bee seene: which arches of vision in fixed starres are greater or lesser, according to the magnitude of the said starres, for to those starres, that be of the first bignesse, they make the arch of vision to containe 12 degrees, and to those of the second bignesse 13 degrees, and to those of the third bignesse 14 degrees, and to those of the fourth bignesse 15 degrees,  
Y and



and to those of the fifth bignesse, 16 degrees, and to those of the sixth bignesse 17 degrees, and to the least fixed stars of all, they appoint 18 degrees, which 18 degrees is the beginning as well of the day light in the morning, as of the twilight in the evening: for when the Sunne is departed from the Horizon 18 degrees, either upward or downward, it beginneth to waxe day light in the morning, or twilight in the evening. Now as touching the quantitie of the said arch of vision belonging to every one of the five Planets, they appoint to Saturne 11 degrees, to Iupiter 10 degrees, to Mars 11 degrees,  $\frac{1}{2}$ . to Venus 5 degrees, and to Mercurie 10 degrees: so as by knowing the degree of the Eclipticke, wherewith any starre riseth or goeth downe, and also the arch of vision, together with the angle of section, whereas the Eclipticke and Horizon doe crosse one another in one selfe part, you shall know what time the starre spendeth in his rising or setting. And for the better vnderstanding of the said arch of vision, *Maginus* setteth downe this figure here following, together with the description thereof, by helpe of certaine letters therein contained.

The

¶ The figure shewing the arch of vision.



**T**His figure as you see consisteth of two whole circles being of like greatnesse, and also it containeth the portion of a great circle. The whole circle, marked with G E C, signifieth the Horizon, whose pole or Zenith is marked with the letter A: and the other whole circle, marked with the letters F E D, signifieth the Eclipticke, whose pole is marked with the letter B: and the letter D sheweth the place of the Sunne, being hidden beneath the Horizon. And imagine the place of the starre his appearing or departing to be in C, in the very Horizon it selfe. Now the portion of the great circle, drawne through the Verticall point of the Horizon, and also through the bodie of the Sunne, is marked with

Y ij

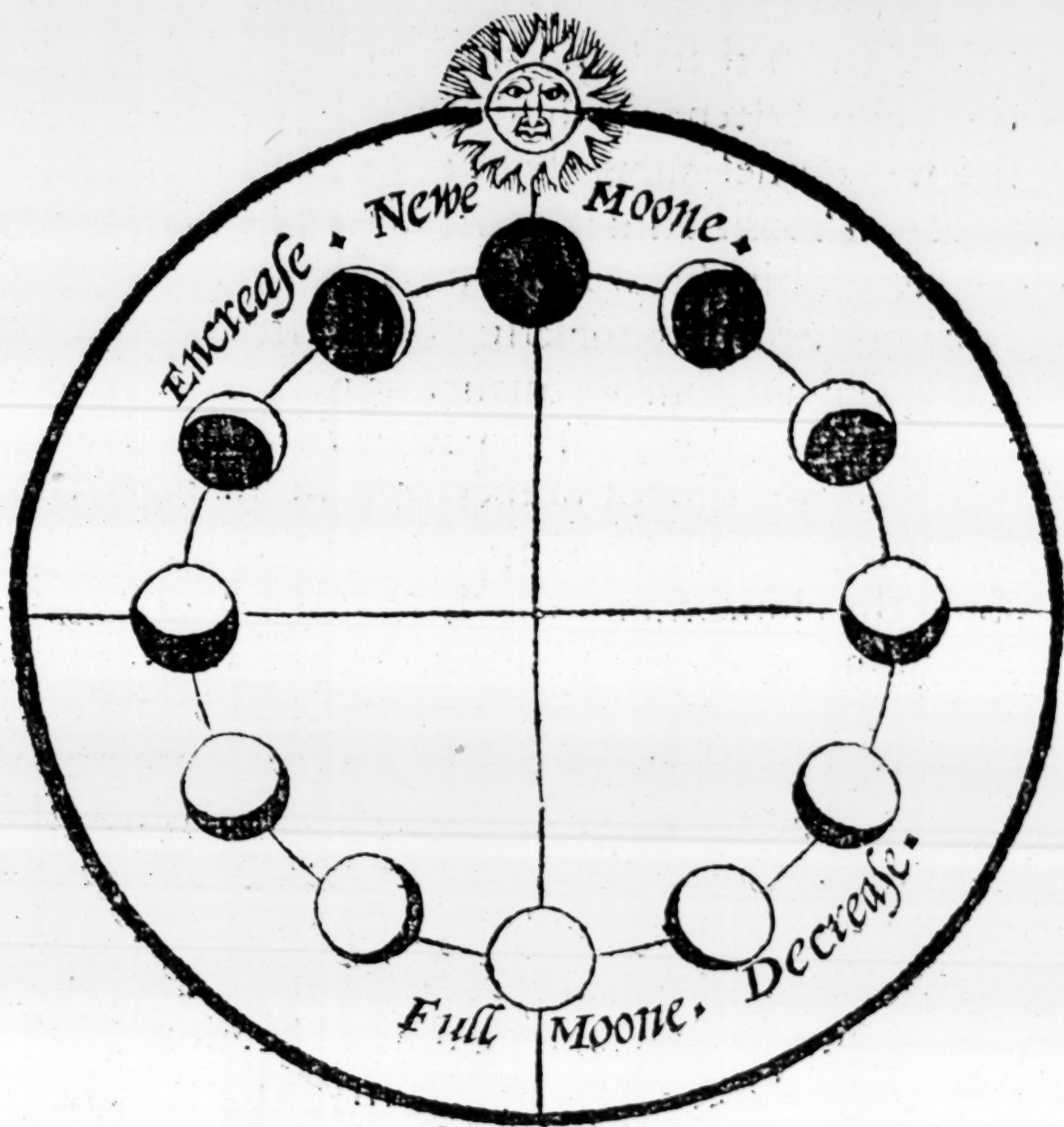
the



the letters A C D. And the arch C D is the arch of vision. But now you haue to vnderstand, that the Moone obserueth not like law or order of hir appearing, after that she hath been in Coniunction with the Sunne. For though the auncient Astronomers, as *Theon*, *Alexandrinus*, *Alfraganus*, *Albategnus*, and others, doe appoint to her arch of vision twelue degrees of the Æquinoctiall, yet that is not alwaies certaine, but sometime more, and sometime lesse, sith the Moone doth shew her selfe sometime sooner and sometime later after her Coniunction with the Sunne, and that for three causes or respects, first by reason of the inclination of the Zodiake to the Horizon, for whilest she is in the ascending halfe of the Zodiake, which is from the beginning of Capricorn to the end of Gemini, which is the halfe of long discension, she appeareth sooner aboue the Horizon, than when she is in the other halfe of short discension, which is from Cancer to Capricorne, because the Moone goeth downe later and not before that the Sunne be deeply hidden vnder the Horizon, making thereby a greater twilight. The second cause is the latitude of the Moone from the Ecliptick, for the more North latitude she hath, the more slowly she goeth downe, and therby is the sooner scene, and specially to those that dwell betwixt the Tropicke of Cancer, and the circle Artique. The third cause is the swiftnesse of her true mouing, for in her swift mouing she is sooner scene than in her slow mouing. And when all those three causes do concur, it is possible that she may bee scene the selfesame day that the change is, albeit that seldome chanceth, and that onely in those places, whose latitude is very farre Northerne. But if two of the foresaid causes doe concur, then she  
may

may be scene the next day after her Conjunction with the Sunne : if there be no more but one cause, then she is commonly scene the third day after the change. But if she be in the descending halfe of the Zodiacke, and haue therewith South latitude, and is slow of gate, there may passe foure daies before she appeareth. Here also it is meet to speake of the diuersitie of her shape, according as she is distant from the Sunne, as well in her increase as decrease : for during her increase, shee followeth the Sunne, and turneth her hornes from the Sunne towards the East, and her lightsome part to the Sunne, and riseth aboute the Horizon immediatly after the Sunne is set. But during her decrease, which is from the full vnto the change, she goeth before the Sunne, and turneth her hornes towards the West, and riseth in the morning before the Sunne. And as for the diuers names which she hath both in Greeke and Latine, according to hir diuers aspects to the Sunne, are plainly set down before in a table made by *Reinholdus*, which table immediatly followeth the third figure belonging to the Theorique of the Moone ; and therefore I would wish you to resort thereunto, because I thinke it superfluous to repeat it againe here. Notwithstanding loe here the figure which is commonly vsed to shew the diuerse shapes of her light, as well in her encrease as decrease.





*The fourth generall kind of passions of the Planets, that doe  
change by comparing their movings vnto the globe  
of the earth,*

**U**t you haue to vnderstand, that the passions ri-  
sing of this comparison, are not so properly inci-  
dent to all the Planets, as to the Moone; because  
that the greatnesse of the earth is not to be esteemed in  
respect of the other Planets, or at the least not with any  
great sensibillitie or affection.

*Shew*

*Shew what passions the Moone hath to the earth, or the earth to the Moone?*

**T**Hese three here following: for first the greatnesse of the earth doth not suffer the true place of the Moone to be all one with her visible place.

Secondly, the earth sometime taketh away the light of the Sunne from the Moone, and so causeth her to be eclipsed.

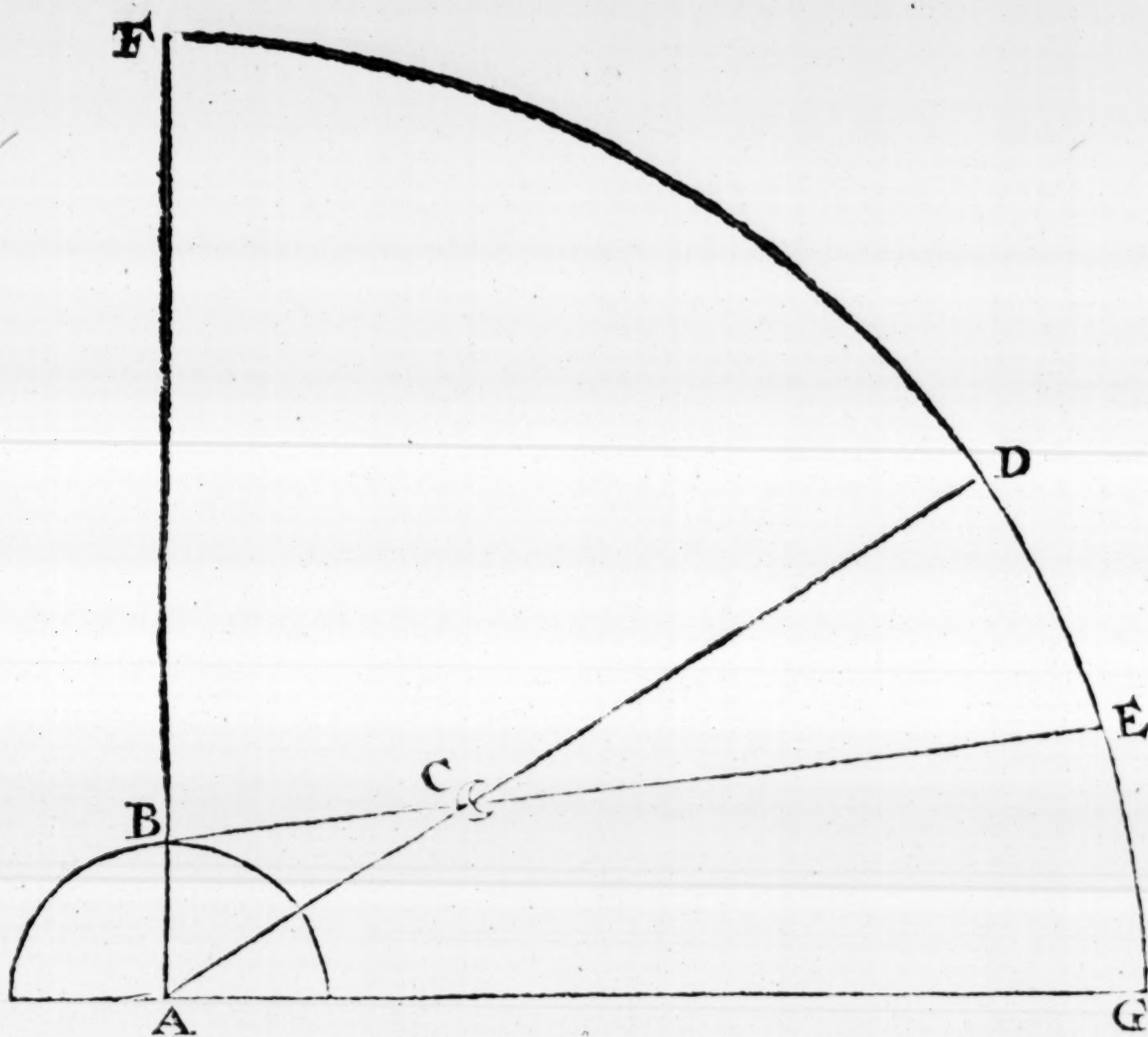
Thirdly, the Moone with her apparent magnitude taketh away the light of the Sun, causing the same in some parts of the earth to be eclipsed. And hereof dependeth the whole doctrine of the Eclipses, whereof we shal treat hereafter.

*In the meane time shew what is the true place, and also what is the visible place of the Moone, or of any other starre?*

**T**He true place of the Moone or of any other starre, is a point in the outermost heuen, determined by a right line beeing drawne from the very centre of the earth through the bodie of the Moone or starre, vnto the said outermost heauen. And the visible place to our sight, is a point in the outermost heauen, determined by a right line passing through the body of the Moone or star from our eie vnto the said heauen, whilst we stand vpon the vpper face of the earth to behold the starre. And the distance or portion of circle contained betwixt those two points, is called in Greeke *Parallaxis*, which in English may be called the diuersitie of Aspects. All which things you may see plainly expressed in this figure following.

This





**T**His figure as you see is made like a Quadrant : the nether right line whereof, commonly called the Base, signifieth the Horizon, and the perpendicular right line falling vpon the same, and making therewith a right angle, is the axletree of the Horizon : and the said right angle, marked with the letter A, signifieth the centre of the earth, whose halfe globe, made like a halfe circle, is drawne vpon the said centre, and the short line, marked with the letters A B, signifieth the semidiameter of the earth, & the letter F signifieth the Zenith, from which F to G is drawn the arch of the Quadrant, signifying here the Verticall circle. And you haue to vnderstand,

derstand, that the right line that is drawn from A throgh the bodie of the Moone, marked with the letter C vnto the point D, set downe in the arch of the Quadrant or Verticall circle, sheweth the true place of the Moone: and the right line drawne from B, through the bodie of the Moone vnto the point of the foresaid arch, marked with E, sheweth the apparent place of the Moone visible to our sight from the vpper face of the earth: and the little arch contained betwixt D and E, is the Parallax or diuersitie of Aspects. And you haue to note, that the apparent or visible place of the Moone is alwayes lower in the heauen, than her true place, vnlesse the Moone doe chance to be in the right line of the Zenith, for then there is no Parallax at all, because both the lines and places do concur and meet in one, as the two lines A B and B F doe shew, making both one selfe line: and the further that the Moone is distant from the earth, the lesser is the Parallax, and the nigher that shee is to the earth, the greater Parallax she hath. But the true quantitie of her Parallax in euery place is to be learned by the Prutenicall tables. And you haue to vnderstand, that the Astronomers doe make the Parallax of the Moone to be threefold, that is, first simple, then according to longitude, and thirdly according to latitude. For if you haue onely respect to the Verticall circle, then it is said to be simple, which is before defined: but if you haue respect to the Zodiacke, then it is said to be sometime according to longitude, and sometime according to latitude.



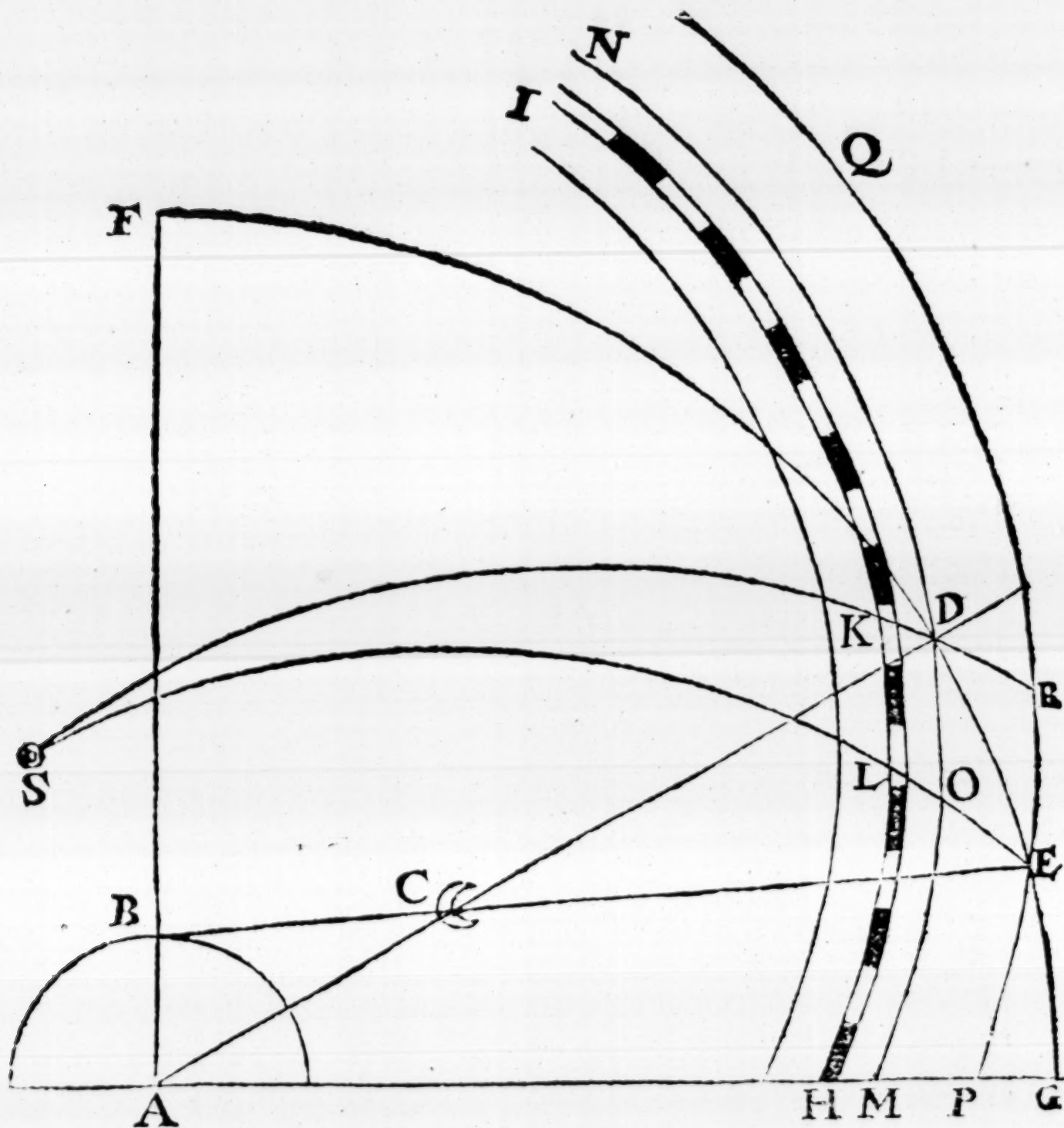
*What is the Parallax according to longitude?*

**I**T is an arch of the Eclipticke, intercepted or contained betwixt two great circles drawn through the poles of the said Eclipticke; so as the one circle dooth passe through the true place of the Planet, and the other great circle passeth through the apparent or visible place of the said Planet.

*What is the Parallax according to latitude?*

**I**T is an arch of a great circle, falling perpendicularly vpon the Eclipticke, and is drawne either through the true place, or els through the apparent and visible place of the Moone, which arch is intercepted betwixt two circles, paralels to the Eclipticke, whereof the one passeth through the true place, and the other through the apparent place of the Moone. For the better vnderstanding of all which things, it shall be necessarie to set down here once againe the Quadrant before described, together with his proper letters of signification; and then to adde to the said Quadrant the Eclipticke line, and also the two circles which are paralels to the same; and thirdly, the two circles that are drawne from the pole of the Zodiacke, so as the one may passe through the true place, and the other through the apparent place of the Moon: all which things this figure plainly sheweth.

*A figure shewing all the three kinds of Parallaxes.*



*The description of the figure.*

**F**irst the Quadrant of this figure, together with his former letters, doe shew the simple Parallax, otherwise called of some the mixt Parallax, because it comprehendeth both the other two Parallaxes, vnto

 $Z_{ij}$ 

**which**



which Quadrant is added first the Eclipticke line, deu-  
 ded into degrees, and is signified by the letters I H: the  
 arch whereof, marked with K L, intercepted betwixt  
 the true and apparent place of the Moone, sheweth the  
 Parallax according to longitude: then the two circles,  
 Paralels to the Eclipticke, which are marked with the let-  
 ters N M, and Q P, through which two Paralels, and  
 also through the Eclipticke are drawne from the pole of  
 the Zodiacke, marked with S, two great circles, whereof  
 the one passeth through the true place of the Moone,  
 marked with S D R, and the other passeth through the  
 apparent place of the Moone, marked with S O E: so  
 as each of the arches, intercepted betwixt the foresaid  
 Paralels, that is to say, either D R or O E, signifieth  
 the Parallax according to latitude; and the Diagonall  
 arch, marked with the letters D E, doe shew the simple  
 or mixt Parallax.

*How the two Parallaxes of longitude and latitude are to bee  
 compared together.*

**T**O doe this, it is first necessarie to know what the 90  
 degree of the Moon is, which is a point in the Eclip-  
 ticke, deuiding that semicircle of the Eclipticke, which is  
 aboue the Horizon, into two equall Quadrants, and is in  
 the very middest of the said semicircle betwixt East and  
 West: and this point is readily found by helpe of a cele-  
 stiall globe, in manner and forme following. For first ha-  
 uing set the globe at our latitude, which is 52, suppose  
 the Moone to be in the first point of Taurus: here if you  
 bring that point to the mouable Meridian, you shal find,  
 that the 17 of Leo then riseth aboue the Horizon, and  
 that

that the 17 of Aquarius goeth downe beneath the Horizon, which is the one halfe of the Eclipticke; of which halfe, by counting 90 degrees from the East point, that is, from the 17 of Leo, and so forward, you shall find, that the 17 of Taurus is the middle point or 90 degree, and the same to be nigher to the South than to the East. Now how to compare together the two foresaid Parallaxes, these five rules following doe shew.

1. First, if the Moon be in the 90 degree of the Eclipticke about the Horizon, then there is no Parallax of longitude, but only of latitude.

2. Secondly, when the Eclipticke passeth through the Zenith, there is no Parallax of latitude, but onely of longitude.

3. Thirdly, when the Eclipticke passeth not through the Zenith, the two foresaid Parallaxes shall be differing one from another, and shall not fall one into another.

4. Fourthly, to those that have more latitude than 30 degrees, the Moone alwaies appeareth more to the South, because her Parallaxes doe alwaies fall more Southerly.

5. Fifthly, the Moone from her rising vntill she come to the 90 degree, appeareth more Eastward: but from the 90 degree to her setting, she appeareth more Westward, as the globe plainly sheweth.

*How to know whether the Moone be in the 90 degree, or not.*

**Y**OU shall know this by obseruing the hornes of the Moon, for if both the tips of the horns of the Moon doe rightly hang one ouer another by a perpendicular line,



line, then the Moone is in the 90 degree of the Ecliptick about the Horizon: but if the vpper horne doe more encline to the East than the nether horne doth, then the Moone is short of the 90 degree. But if the vpper horn be more to the West, then the Moone is past the 90 degree.

And here I end with the description of the Parallax, and all the kinds thereof: minding now to treat of the Eclipses of the Sunne and Moone, which are meet to be accounted amongst the cheefest Passions of these two Planets.

*Of the Eclipses of the Sunne and Moone, and first of the Moone.*

**T**Hough this word Eclipse may be generally taken for the hiding or darkening of any star from our sight, yet here it is cheefely to be referred to the Eclipse of the Sunne or Moone, which is the depriving of their light from the sight of vs that dwell here vpon the earth: but first wee will treat of the Eclipse of the Moone, and shew how and when it chanceth. The Moon hauing no light of it selfe, but onely from the Sunne, is neuer eclipsed, but when the earth is betwixt her and the Sunne, which cannot chance, but when the Moone is at the full, and diametrally opposit to the Sunne: and also when such Opposition is either in the head or taile of the Dragon, or somewhat nigh therunto, which are nothing els but two sections of two circles, that is, the Eclipticke and the deferent of the Moone, cutting one another in two opposite points, otherwise called the two Nodes, which are before described in the Theorique of the Moone,

Moone, and are also plainly declared in the first part of my Sphere, chap. 15. But for so much as there be many other needfull things to be knowne touching those two Eclipses, I mind here to treat thereof more at large.

And first of the Eclipse of the Moone, shewing first the causes why her eclipse is not alwaies after one maner.

Secondly, what shape the shaddow of the earth hath at the time of her Eclipse, and how many kinds of shaddowes there be.

Thirdly, how many waies she may be said to be eclipsed, either totally or in part.

Fourthly, which be the bounds, within which she being at the full, may be eclipsed.

Fifthly, how many points or digits she may be eclipsed.

Sixtly, what things are to be considered touching the durance or continuance of her Eclipse, & how they are defined. And lastly, at what part the Moone beginneth to bee eclipsed, and from what part her light is to her againe restored.

The causes why the Eclipse of the Moone is not alwaies after one maner, but variable as well in magnitude as in continuance, are these foure here following.

1. The first cause is the vnequall latitude of the Moon, for sometime her latitude is very little or nothing at all, and then is her eclipse greater in magnitude, and longer in continuance: and sometime her latitude is so great, that she commeth but a very little within the shaddow of the earth, and thereby looseth but a small portion of her light: and sometimes she commeth not within the compasse of the shaddow of the earth at all, and so she is not eclipsed. For this is a generall rule, that when the latitude of the Moone, at the time of the true Opposition  
of



of the Moone and Sunne is lesse than the summe of the two semidiameters, that is, of the shadow and of the Moones bodie, being added together, there will be an Eclipse of the Moone. And the greater and more that the excesse of those two semidiameters of the Moon and of the shadow is than her latitude, the greater and longer will the Eclipse be. And if the summe of those two semidiameters bee just equall vnto the latitude of the Moone, then she shall onely touch the shadow, and so passe without any Eclipse.

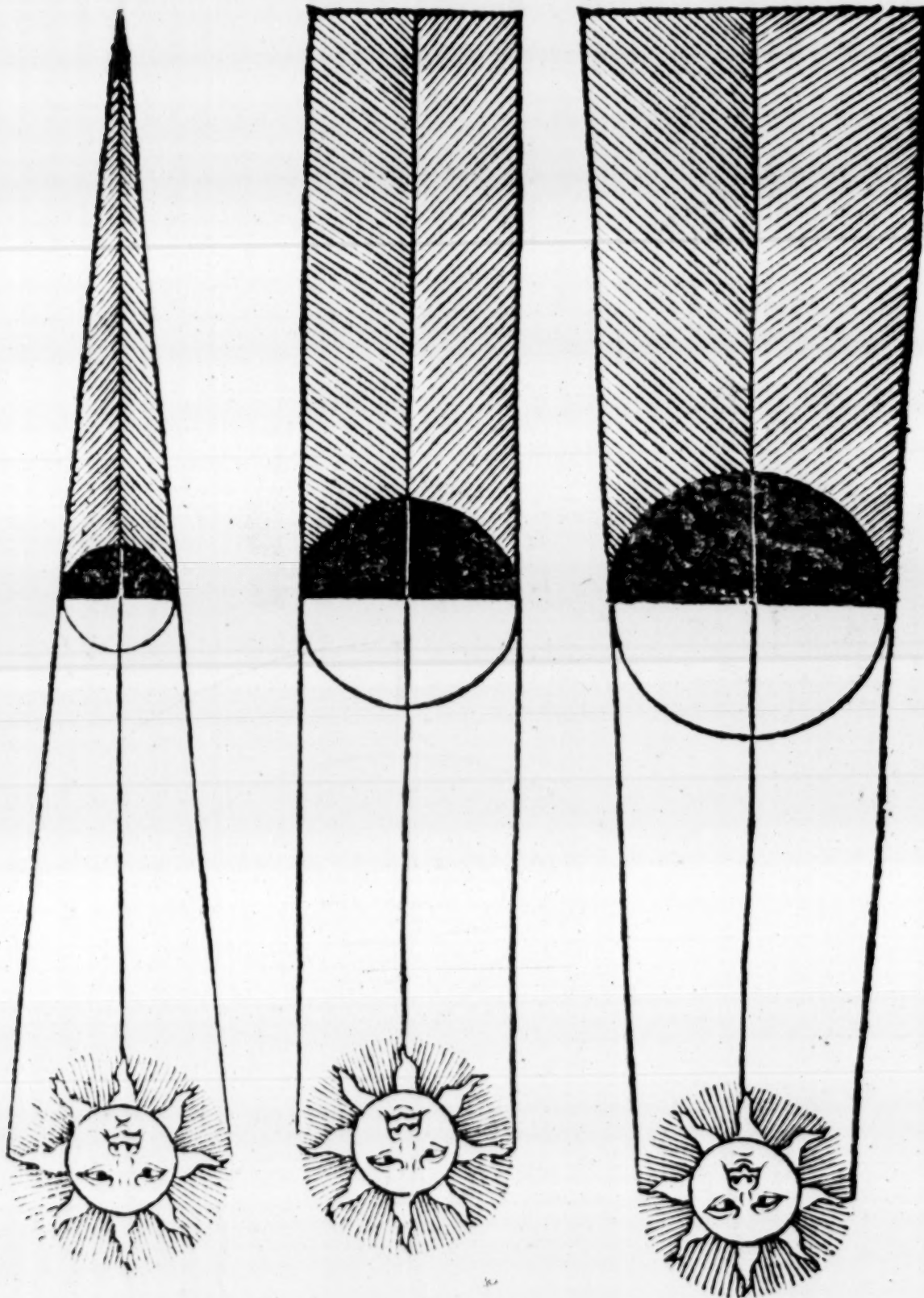
2. The second cause of the change or variable shape of the eclipse of the Moone, is the vnequall thickenesse of the shadow of the earth: for the higher that the shadow of the earth ariseth, the more narrow it groweth, ending with a sharpe point, because the bodie of the Sun is greater than the bodie of the earth, and therefore the shadow cannot be of any other shape than Conicall: for there be three kinds of shadowes, that is, Conicall, Cylindricall, and Calathoidall. The shadow Conicall is that which endeth with a sharpe point. The Cylindricall is of like bignesse euery where, like a round pillar. And the Calathoidall shadow, the further it extendeth, the greater it is, like a cup or bowle, that is narrow at the bottome and broad at the brim; of which shape that shadow taketh his name, for *Calathos* in Greeke is as much to say as a cup: as these three figures doe plainly shew.

*Conicall.*

Conicall.

Cylindricall.

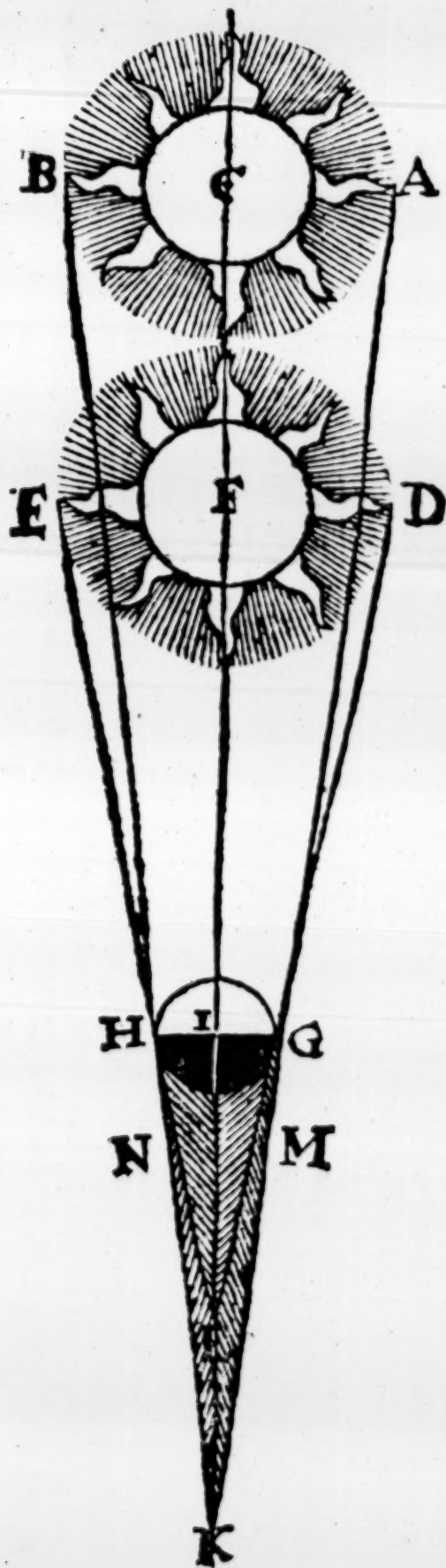
Calathoidall.



And it is to be noted, that when the Moone is in the lower part of her Epicycle neare vnto the opposite Auge thereof, her Eclipse continueth longer than it doth when she is neer vnto the Auge of her said Epicycle.



3. The third cause is the variable thickenesse of the shadow which the earth yeeldeth, according as the Sun is either in the Auge or opposit Auge of his Excentrick, as you may easily perceiue by this figure following, consisting of three circles and certaine right lines.



**I**N which figure, each one of the two vpper circles signifieth the bodie of the Sunne: and the little circle made halfe blacke, signifieth the bodie of the earth. Suppose then the point C in the vpper circle to signifie the centre of the Sunnes bodie, being in his Auge: and the point F in the second circle to be the centre of his body, being in the opposit Auge of his Excentrique: and suppose the letters H G to be the diameter of the earth: and the letter I to be the centre of the earth. Here you see, that when the Sunne is in C, the shadow extendeth further with his sharpe point, than when the Sunne is in F; for then the foresaid shadow endeth at the point L, and so the shadow is shorter and narrower. For if the outermost lines A G, and B H, touching the earth, be drawne out in length, they

they will meet in the point K, making the shaddow to be G H K, whose axletree is the middle line I K, determined by the letters C I K. But if the two right lines D G and E H be drawne out, they will meet in the point L, so as the axletree of the shaddow shall be I L, which is shorter than the axletree I K: and therefore the Moone being in the beginning of her Eclipse in the point M, and hauing to passe to N, findeth the shaddow to bee thicker when the Sunne is in the Auge of his Excentrique, than when he is in the opposit Auge thereof, and thereby the Eclipse of the Moone is then both greater, and continueth longer. To know the exact quantitie of such shaddow at any time is to be learned by the Prutenicall tables.

4. The fourth cause of the varietie of her Eclipses is her vnequall mouing in her true motion, either swift or slow, for when she is in her swift motion, the continuance of her Eclipse must needs be shorter than when she is in her slow motion. And to know her houely motion, either meane or true, is to be found by the Prutenicall tables.

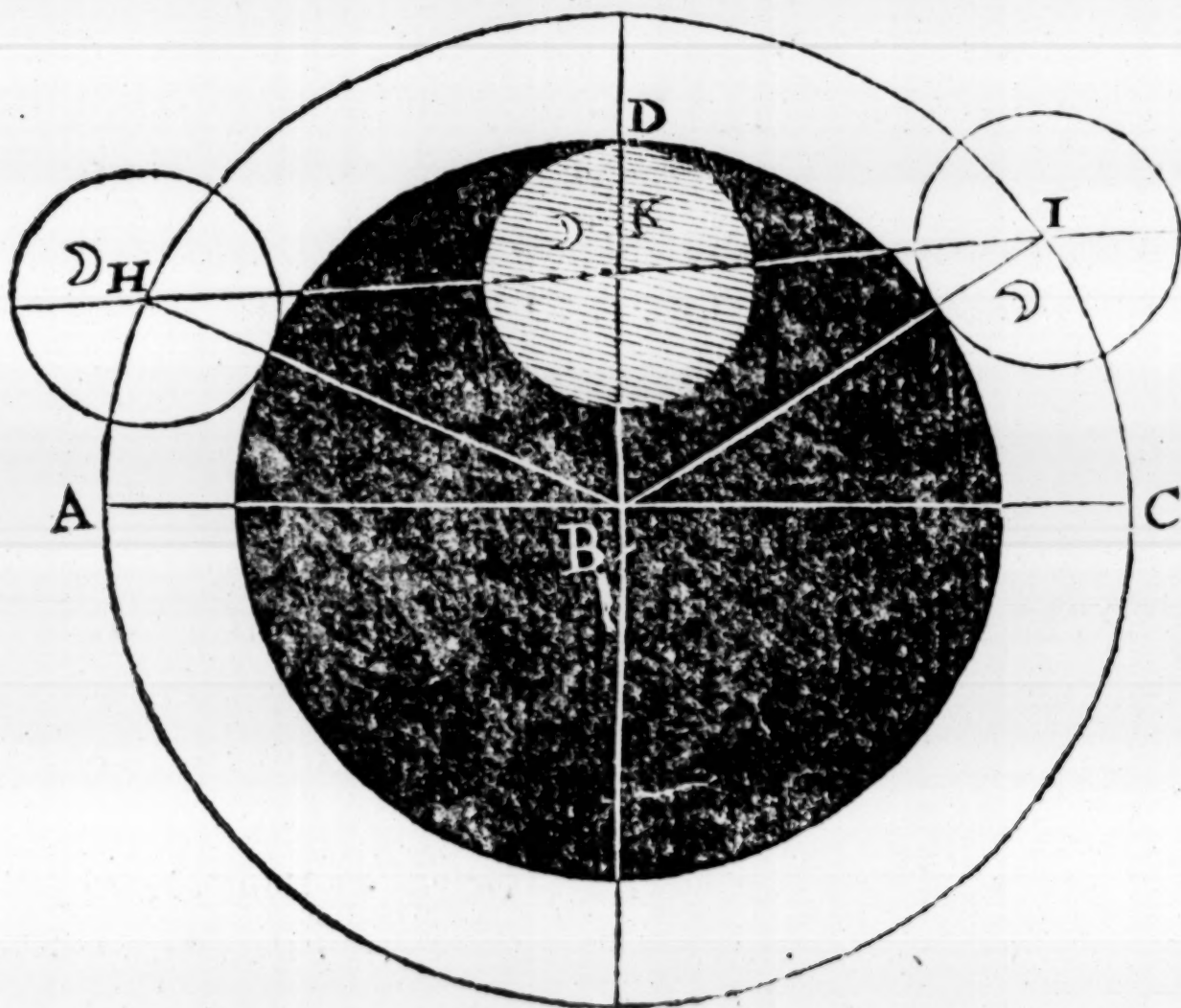
But now though her Eclipse be thus variable, as you see, yet such varietie may be brought into two cheefe heads, that is, when she is said to be totally, or partly, eclipsed; whereof we come now to speake.

The totall Eclipse of the Moone is twofold, that is, either without any continuance of time, or els with some continuance of time. In the former, so soone as she hath lost her whole light, she presently beginneth to recouer the same again: but in the latter, she being wholly eclipsed, the same continueth some quantitie of time. The first way chanceth when the latitude of the Moone and



the semidiameter of her bodie being both added together, the summe thereof is equall vnto the semidiameter of the earth, as this figure plainly sheweth.

¶ *The first figure belonging to the Eclipse of the Moone.*



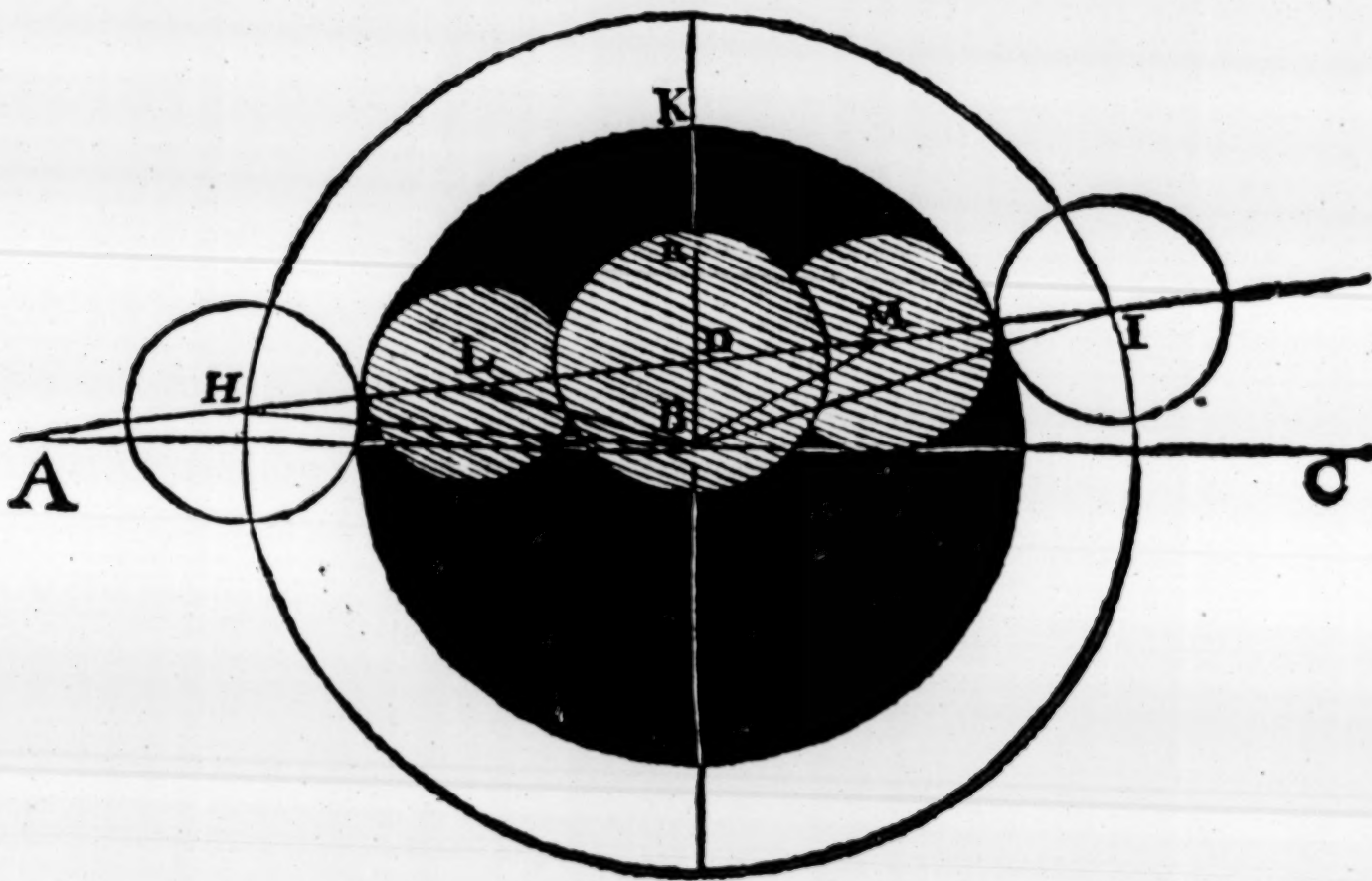
**I**N which figure, the great blacke circle signifieth the shadow of the earth, and the three lesser circles being all of like bignesse, each of them representeth the body of the Moon: and what the right lines doe signifie, the letters doe shew: for the letters B D doe represent the semidiameter of the shadow of the earth, when the Moone is eclipsed: and

and B K sheweth the latitude of the Moone from the Eclipticke, which Eclipticke is marked with the letters A C. Now K D signifieth the semidiameter of the Moons bodie, and the letter I sheweth the centre of her bodie in the beginning of her Eclipse, and the letter H the centre of her body at the end of her Eclipse. And the right line I K H signifieth the way of the Moon during the time of her Eclipse. Here for so much as the two semidiameters D K, and K B, being both added together, are equall vnto B D, which is the semidiameter of the shaddow, you may perceiue, that the Moone being in the point I, began to loose her light by little and little, vntill she came to the point K, and there was wholly darkened, from whence she presently began again without any stay to recouer her light, vntill she came to the point H, whereas she is fully restored againe to her light.

The second kind of totall Eclipses of the Moone, is when she is wholly eclipsed, and the same continueth some quantitie of time, which alwaies happeneth when the semidiameter of the shaddow of the earth in the place of the Eclipse, is greater than the latitude of the Moone and of her bodily semidiameter being both added together: as this second figure next following plainly sheweth.



¶ The second figure belonging to the Eclipse of the Moone.

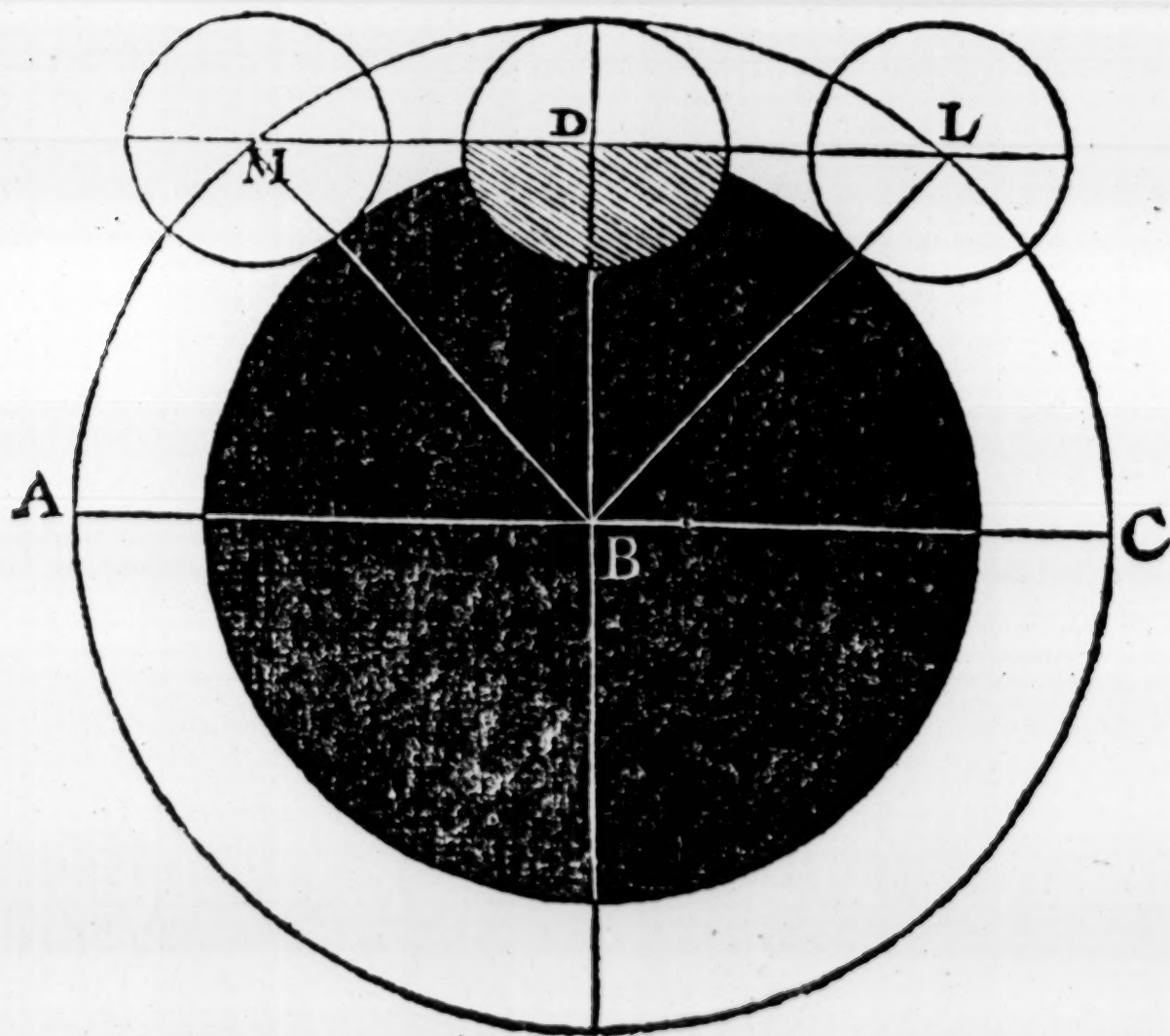


**I**N which figure, suppose the semidiameter of the shadow of the earth in the place of the Eclipse to be the line B K, and the line B D to be the latitude of the Moone at the time of the middle of the Eclipse from the Eclipticke, marked with the letters A C, and the line R D to be the semidiameter of the Moon, & H I to be the way of the Moon in the time of her darkeness, and I to be the place of the beginning of her Eclipse, and H the ending of the Eclipse, and M her place when she is wholly darkened, and L her place when she beginneth to recouer her light againe. Now you see, that when she commeth to the point M, shee is wholly eclipsed, like as she is also when she commeth to the

the

the point L, and because she spendeth some quantitie of time in going from M to L, and is wholly darkened, therefore is this called a Totall Eclipse with continuance. Thus much touching the Totall Eclipse of the Moone, now we will speake of the Partiall Eclipse of the Moone. The Partiall Eclipse is when some part of the Moone is darkened, and not the whole: and of this Partiall Eclipse there are three sorts. The first is, when halfe of the Moones diameter is darkened, and the other halfe keepeth still her light, which happeneth when the latitude of the Moone is equall vnto the semidiameter of the shadow of the earth in the place of the Eclipse, as you may perceiue by this third figure next following.

¶ *The third figure belonging to the Eclipse of the Moone.*

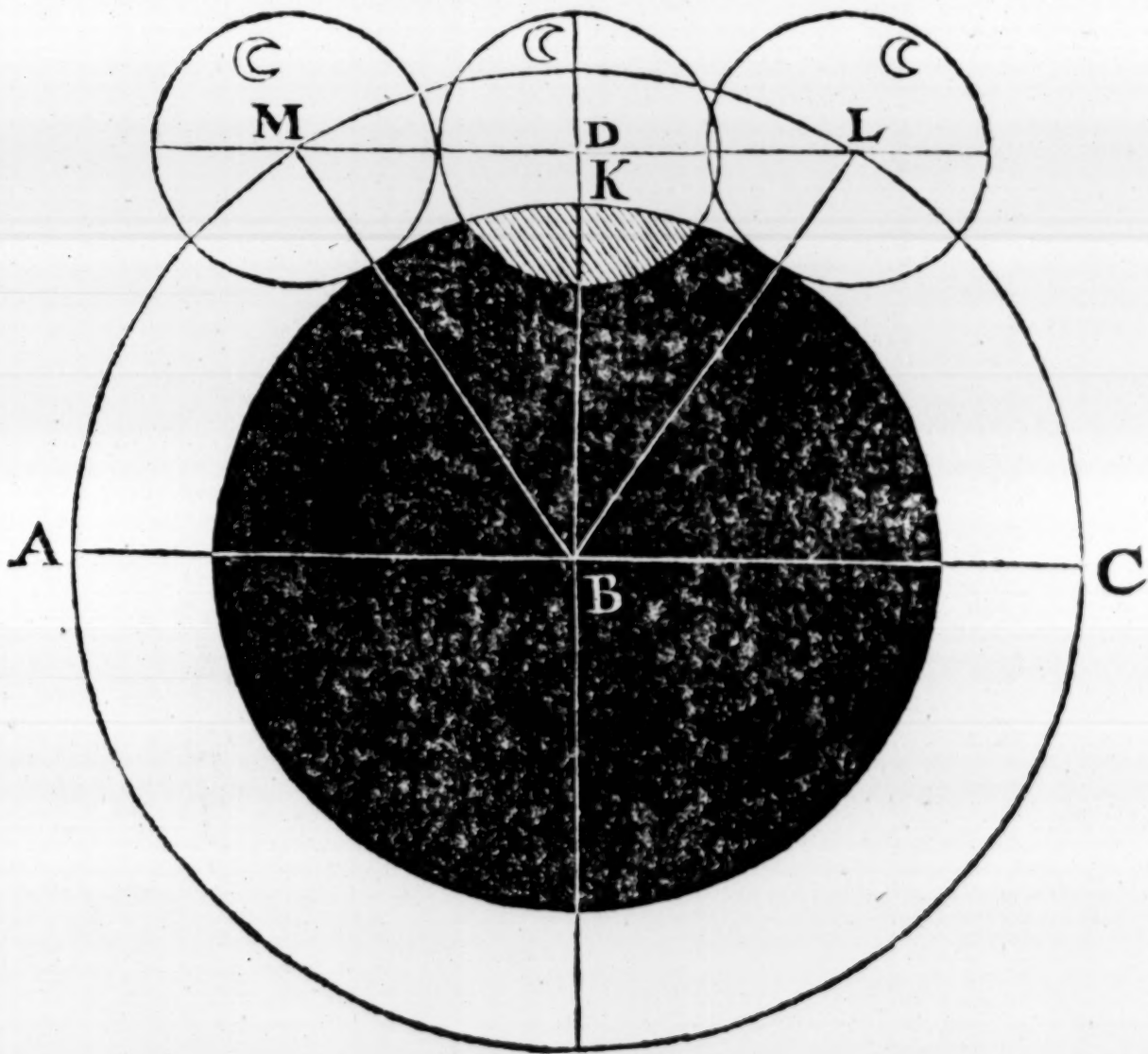




**I**N which figure, B D signifying the latitude of the Moone from the Eclipticke A C, is just equall vnto the semidiameter of the shadow of the earth, marked also with B D.

The second sort of partiall Eclipse of the Moone, is when a lesser part than the semidiameter of the Moone is darkened, which happeneth when her latitude is more than the semidiameter of the shadow of the earth, as you may see by this fourth figure.

*¶ The fourth figure belonging to the Eclipse of the Moone.*

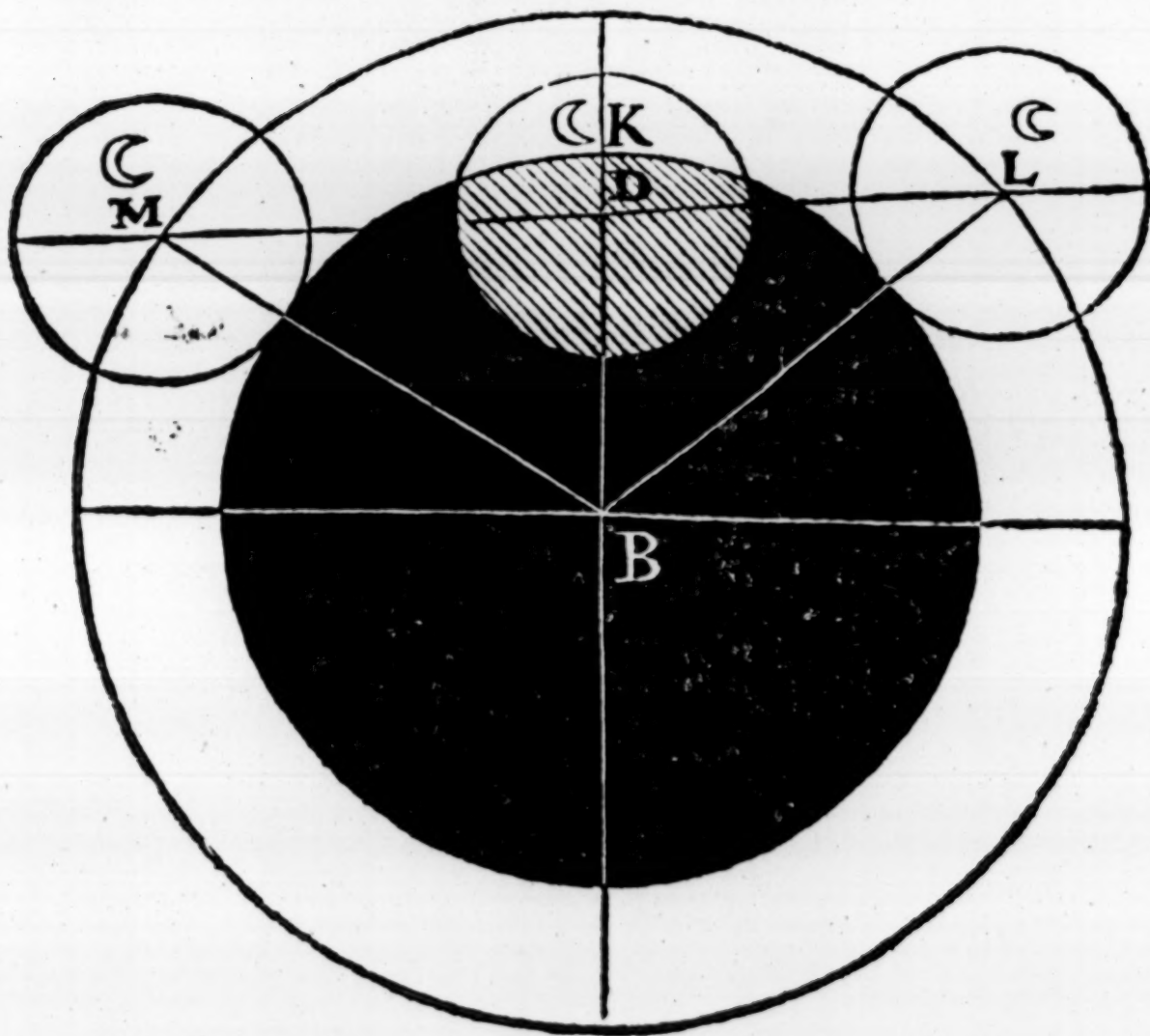


**I**N which figure B K signifieth the semidiameter of the shadow, and B D signifieth the latitude of the Moon:  
now

now for that B D is more than B K, you see that there is but a little of her light taken away by the shadow of the earth.

The third sort of Partiall Eclipses is, when more than the semidiameter of the Moone is darkened: which happeneth when the latitude of the Moone is lesse than the semidiameter of the shadow of the earth, as you may see by this fift figure.

¶ *The fift figure belonging to the Eclipse of the Moone.*



IN which figure, B D signifying the latitude of the Moone, is lesse than B K, representing here the semidiameter  
B b                      diameter



diameter of the shadow, and therefore more than the semidiameter of the Moone is eclipsed.

*How to know the bounds or limits, whereby is easily knowne what kind of Eclipse of the Moone will happen when she is at the full.*

**T**He limits are most certainly knowne by the latitude of the Moone at the time of her true opposition to the Sunne: for if you find the latitude of the Moone by the Prutenicall tables, or otherwise, to be more than the summe of the semidiameters of the shadow and of the Moon being added together, then there will be no Eclipse at that full; but if the latitude of the Moone be lesse than the summe of the two said semidiameters added together, you may be sure, that the Moon will be eclipsed at her full: so that the termes or bounds of the Eclipses are knowne by comparing the latitude of the Moone with the summe of the foresaid two semidiameters being added together. The least summe of which two semidiameters, that is to say, of the Moone and of the shadow of the earth is  $\frac{1}{3}^{\circ} \frac{11}{3}'$ , which is, when the Moone is in the Auge of her Epicycle, and the Sun in the opposit Auge of his Excentrique, and that in his least excentricitie. But the greatest summe of the said apparent diameters that can bee, is one degree,  $\frac{1}{2}^{\circ} \frac{11}{2}'$ , which happeneth when the Moone is in the opposite Auge of her Epicycle, and the Sunne in the Auge of his Excentrique, and that in his greatest excentricitie. And hereof you may gather these three rules.

First, if the latitude of the Moone at the time of her true opposition to the Sunne be lesse than  $\frac{1}{3}^{\circ} \frac{11}{3}'$ , shee must needs be eclipsed.

Secondly,

Secondly, if her latitude be more than  $\frac{1}{67} \cdot \frac{11}{12}$ . shee cannot be eclipsed at the Full.

Thirdly, if her latitude be more than  $\frac{1}{53} \cdot \frac{11}{51}$ . and lesse than  $\frac{1}{67} \cdot \frac{11}{52}$ . then she may happen to be eclipsed, but not necessarily. And these bounds or limits may also be determined by the distance of the Moone from any of the two Nodes, that is, from the head or taile of the Dragon, which distance is neuer lesse than 10 degrees,  $\frac{1}{22}$ . neither at any time greater than 13 degrees,  $\frac{1}{3}$ . which bounds or limits are set downe by *Ptolomey* thus. If the distance of the Moone at the time of her true Opposition from either of the two Nodes, be lesse than 12 degrees,  $\frac{1}{12}$ . or if the said distance of the Moone from either of the said Nodes at the time of her meane Opposition, bee lesse than 15 degrees, and  $\frac{1}{12}$ . (the said distance being reckoned either according to the succession of the signes, or contrarie to the succession of the signes, vpon the Eclipticke) then the Moone may be eclipsed.

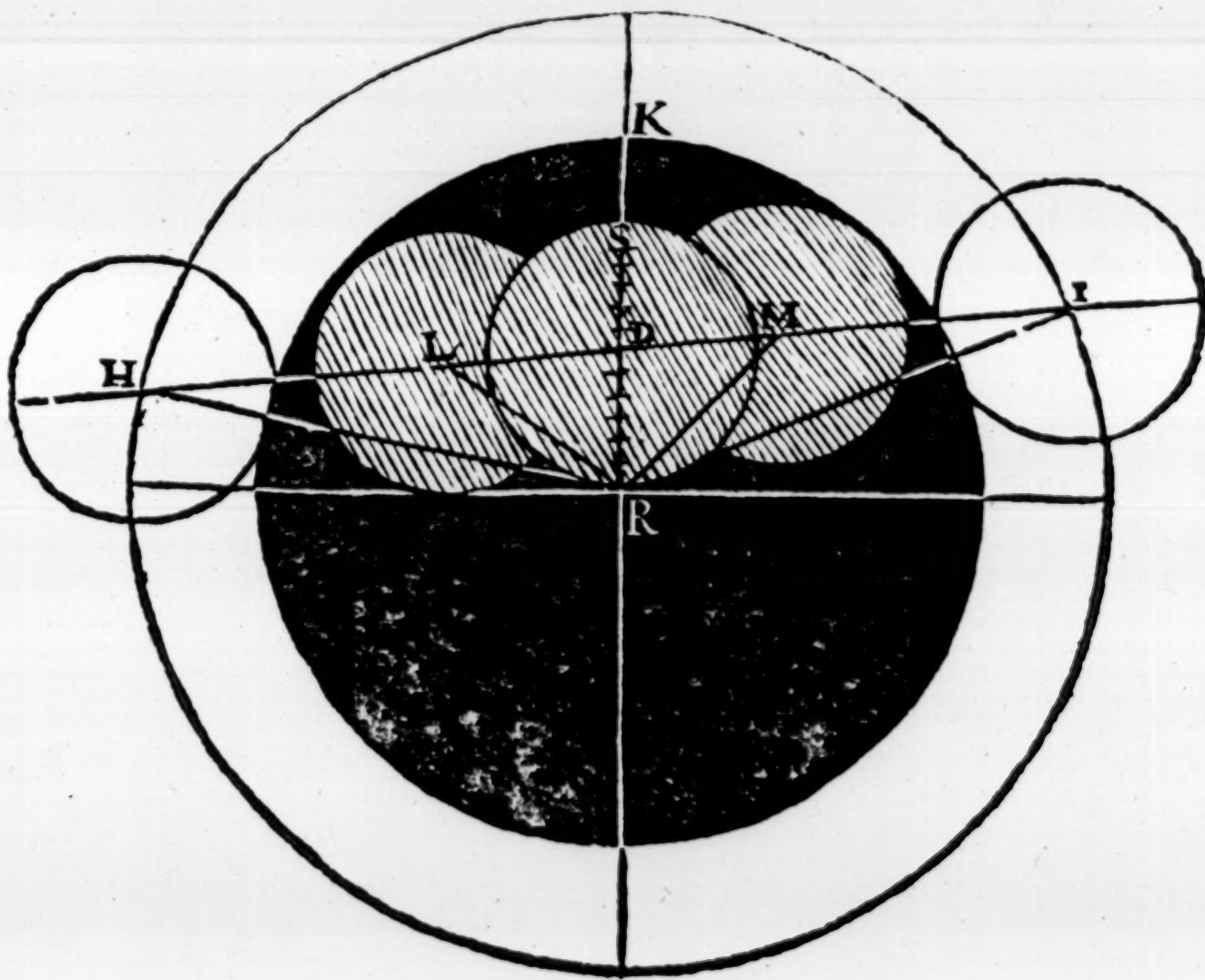
*Of the twelue Digits, whereinto the bodie of the Moone is wont to be deuided, to know thereby how much at any Full she is eclipsed.*

**T**Hough that the diameters of the Moone and of the shadow may bee accounted by degrees and minutes, yet notwithstanding, the magnitude or greatnesse of her Eclipses is vsually reckoned by digits, or ynches, by deuiding the diameter of her body into 12 equal parts, because her diameter appeareth to our sight as it were a foot in length : and therefore as the foot is deuided into 12 ynches, so is the diameter of the Moone supposed to be also deuided into 12 parts, which parts are



called digits or points, and by them is the greatnesse of her Eclipse determined, and therefore they bee called Eclipticall digits or points. And although that the diameter of the Moone is deuided but into 12 digits, yet neuertheless the Eclipse of the Moone may sometimes happen to be very neer 23 digits, by reason of the thicknesse of the shadow of the earth, whose semidiameter sometime exceedeth the diameter of the Moone, and such excesse is wont to be deuided also into 12 such parts as is the diameter of the Moone, and so the Moon may be eclipsed more than 12 points, as you may more plainly perceiue by this sixt figure next following.

¶ *The sixt figure belonging to the Eclipse of the Moone.*



**I**N which figure, the letters D K representeth the semidiameter of the shadow, and R S the diameter of the Moon at the time of her greatest darknesse. Now supposing the said R S to bee deuided into 12 equall parts, the said 12 parts are called the Eclipticall digits: & for that some part of the semidiameter of the shadow, namely, S K, extendeth further than R S, which is the diameter of the Moone, the ouerplus S K is supposed also to be deuided in this Eclipse into certaine equal parts, namely into three such parts, as the diameter of the Moone containeth 12, so as the eclipticall digits in this Eclipse are 15: for you may easily perceiue, that if the semidiameter of the Moone were longer by three digits than it is, yet it might be wholly eclipsed: and as you see the number of eclipticall digits in this Eclipse to be 15: euen so the number of the said digits may amount sometime to be 22 digits and 51 minutes. For you may remember that I said before, that the summe of the semidiameter of the Moone and of the shadow being added together, may sometimes happen to be  $\frac{1}{17} \cdot \frac{11}{53}$ , when the Sunne is in his greatest excentricitie, and in the Auge of his Excentrique, and the Moone in the opposite Auge of her Epicicle: at which time the semidiameter of the Moone, is  $\frac{1}{17} \cdot \frac{11}{49}$ , and so consequently her whole diameter is  $\frac{1}{17} \cdot \frac{11}{38}$ . then say by the rule of proportion, if  $\frac{1}{35} \cdot \frac{11}{38}$  are equall vnto 12 digits, what shall  $\frac{1}{67} \cdot \frac{11}{32}$  be equall vnto? so shall you find the fourth proportionall number to be 22 digits and 51 minutes: and this is the greatest number of Eclipticall digits, that any Eclipse of the Moone can haue. And the more Eclipticall digits that any Eclipse hath, the longer is the time of durance or continuance thereof.



*Of the continuance of the Moones Eclipse, what it is, and how many things are wont by the Astronomers to be considered therein.*

**T**He continuance of the Eclipse is that space of time which she spendeth in going from the very beginning of the Eclipse to the middest of the same, whereas she is most darkened. And these five things are wont therein to be considered, that is, the minutes of Incidence, the minutes of the halfe continuance, the time of Incidence, the time of halfe continuance, and the halfe continuance it selfe.

1. And first you have to note, that the minutes of Incidence are accounted in partiall Eclipses after one way, and in totall Eclipses with continuance another way: for in partiall Eclipses & also in totall Eclipses without continuance, the minutes of Incidence are said to be the arch of the Moones way which she maketh in her mouing of longitude from the beginning of her Eclipse to the midst thereof, where she is fully darkened, as appeareth by the third, fourth, and fift figures of partiall Eclipses before set down: in all which, the point L signifieth the place of the Moone at the beginning of her Eclipse, and the point D the place of the Moon at the middle of her Eclipse. Now the arch of her way from L to D, is called the minutes of Incidence, for so long her light decreaseth by little and little, vntill so much be taken away, as can be in any of those partiall Eclipses. But if the Eclipse be totall, without any continuance, as in the first figure, then the way of her motion in going from the point I vnto the point K, where she is wholly darkened, is called the scruples of Incidence.

cidence. But if the totall Eclipse haue any continuance, then the minutes or scruples of Incidence are that portion of the Ecliptick, throgh which the Moon goeth from the very beginning of her Eclipse, vntill the time that she be wholly eclipsed, as in the second & last figures the letter I signifieth the point, in which the Moon is at the beginning of her Eclipse, and M the point in which she is fully darkened: and the arch I M is called the minutes or scruples of Incidence, and these minutes in the end of the Eclipse are called minutes of repletion, as in the third, fourth, and fift figures, the arch of the Moons way, namely D M, or K H in the first figure, or L H in the second and last figures, doe shew: which minutes of repletion are reckoned from the very time of the beginning of her clearing vnto the time that she hath fully recovered her whole light: and the minutes or scruples of repletion are equall to the minutes or scruples of Incidence.

2. The second thing which is considered in accounting of the continuance of Eclipses, is the scruples of halfe continuance, which is nothing els but the arch which the Moone maketh in going from the Sunne, from the time of her whole darkenesse vnto the very middle of the Eclipse: from which middle Eclipse, the Moone going still forward vntill she begin againe to recouer her light, the said arch is called the scruples of Emerfion, as in the second and last figures the arch M D doth shew, whereof M representeth the place in which shee loofeth her whole light, vntill she come to the point D, which signifieth her place when she is in the middle of her Eclipse, or in her diametrall Opposition to the Sunne. And this is called the scruples of halfe continuance: but the arch of her motion from D to L, where she beginneth again



to receiue her light, is called the minutes of Emerfion, and thefe minutes of Emerfion are equall vnto the fcruples of halfe continuance, as the fcruples of Repletion were equall vnto the minutes of Incidence.

3. The third thing to be confidered in accounting the Eclipse of the Moon, is the time of Incidence: which is nothing els but the very time which the Moon spendeth in going of the minutes of Incidence, or the time of Incidence is that portion of time which the Moon spendeth in mouing from the beginning of the Eclipse vnto the point where ſhe is moſt darkened (if the Eclipse be partiall) as in the third, fourth, and fiſt figures, the time which the Moone ſpendeth in her mouing from the point L, where ſhe beginneth to bee eclipsed vnto the point D, where her darkeneſſe is greateſt, is called the time of Incidence. Likewise if the Eclipse be totall, the time which ſhe ſpendeth in moouing from the beginning of the Eclipse, vnto the point in which ſhe is wholly obſcured, as in the firſt figure the time which ſhe ſpendeth vnto her mouing from the point I vnto the point K, ſo the time which ſhe ſpendeth in going from I to D, in the ſecond and laſt figures is called the time of Incidence.

4. The fourth thing to be confidered, is the time of halfe continuance, which is that quantitie of time which the Moone ſpendeth in her moouing from the point in which ſhe looſeth her whole light, vnto the point of the middle Eclipse, as in the ſecond and laſt figures the time which ſhe ſpendeth in going from the point M to the point D, is called the time of halfe continuance. And the time which ſhe ſpendeth in her mouing from D to L, in the ſaid ſecond and laſt figures is called the time of her Emerfion: which time is equall vnto the time of halfe

halfe continuance, sauing that the variable motion of the Moone beeing swifter in the one than in the other, may make a little difference, which in so short a time cannot be sensible. And in like manner, the time of Re-pletion is equall vnto the time of Incidence, vnlesse the varietie of her motion doe make a little vn sensible difference.

5. The last thing that is to be considered in the continuance of the Eclipse, is the halfe time of durance, which is nothing els but the time which the Moone spendeth in going from the point in which she began to be eclipsed, vnto the point of the middle Eclipse: and this time is equall to the time of Incidence in Partiall Eclipses, as in the third, fourth, and fifth figures, the time which she spendeth in going from L to D, is the time of halfe durance: and likewise the time which she spendeth in her mouing from I to K in the first figure, is the time of halfe durance: but if the Eclipse be totall with continuance, then is the time of halfe durance equall vnto the time of Incidence, and also to the time of halfe continuance, being both added together.

Furthermore, you haue to note, that the Eclipse of the Moone dooth alwayes begin on the East side of her bodie (I call that the East side which is towards the East) for sith that her motion is from West to East, and that very swift, in respect of the Sunne or of the shaddow of the earth, it must needs follow, that the East side of her bodie first toucheth the shaddow in the beginning of her Eclipse, and so continueth her mouing through the said shaddow, leauing the same behind her on the West side of her bodie. And although that this be true in all Eclipses of the Moone, yet in partiall Eclipses, if the lati-  
C c tude



tude of the Moone be North, then is the South part of her bodie darkened, but if her latitude be South, then is the North part of her bodie darkened. And note, that whensoever any Eclipse doth happen, the said Eclipse may be seene of all them, about whose Horizon she is in the time of her Eclipse, and that at one selfe instant or moment of time, be it the beginning, middle, or ending of any such Eclipse: but it is not so in the Eclipse of the Sunne, neither can any other of the Planets be eclipsed or darkened by the shadow of the earth, because the same shadow reacheth not so high as any of the three higher Planets are: and as for Venus and Mercurie, their place is alwaies so nigh vnto the place of the Sunne, as they cannot be eclipsed at any time.

Thus much touching the Eclipse of the Moone, and now I will speake of the Eclipse of the Sunne.

*Of the Eclipse of the Sunne, how and when it chanceth.*

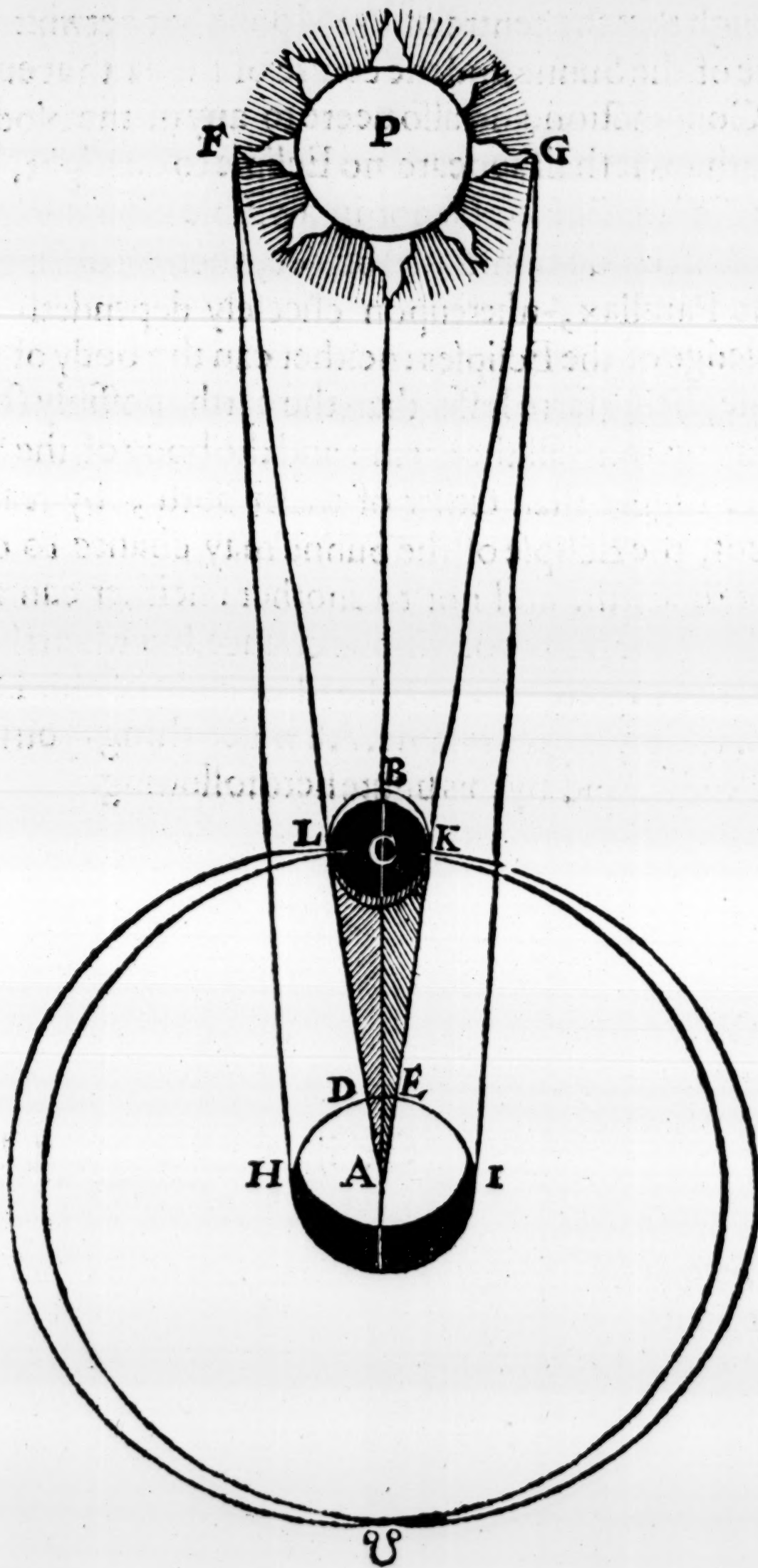
**T**He Eclipse of the Sunne is nothing but the darkening or depriuing of his light from our sight, caused by the interposition of the bodie of the Moon betwixt the bodie of the Sunne and the bodie of the earth: and this Eclipse neuer happeneth but when the Moone and the Sunne are in a visible Conjunction. For you haue to note, that there be three kinds of Conjunctions, that is, meane, true and visible, or apparent to our sight. What the meane and true Conjunction is, hath been before defined: and it is called a visible Conjunction, when a right line being drawn from our eye or sight, passeth through the centre of the Moone vnto the centre of the Sunne, whereby the said two Planets appeare

to our sight to bee in one selfe degree of longitude, that is to say, in one selfe point of the Eclipticke. For although that the centre of the Moone bee betwixt the centre of the Sunne and the centre of the earth at euery true Conjunction, and also neere to any of the Nodes, yet perhaps it shall appeare no Eclipse to our sight, because the two Planets be not in a visible Conjunction, as haue been demonstrated before, when we did speake of the Parallax, whereupon cheefely dependeth the knowledge of the Eclipses: neither can the body of the Moone, being farre lesser than the earth, possibly shadow at any time all the earth: and the body of the Sun is farre bigger than either of them both, by reason whereof, the Eclipse of the Sunne may chance to one part of the earth, and not to another: neither can any Eclipse of the Sunne or Moone chance, but when those two Planets are either in the head or taile of the Dragon, or els very nigh the same. All which things you shal better vnderstand by this figure here following.





¶ The first figure belonging to the Eclipse of the Sunne.

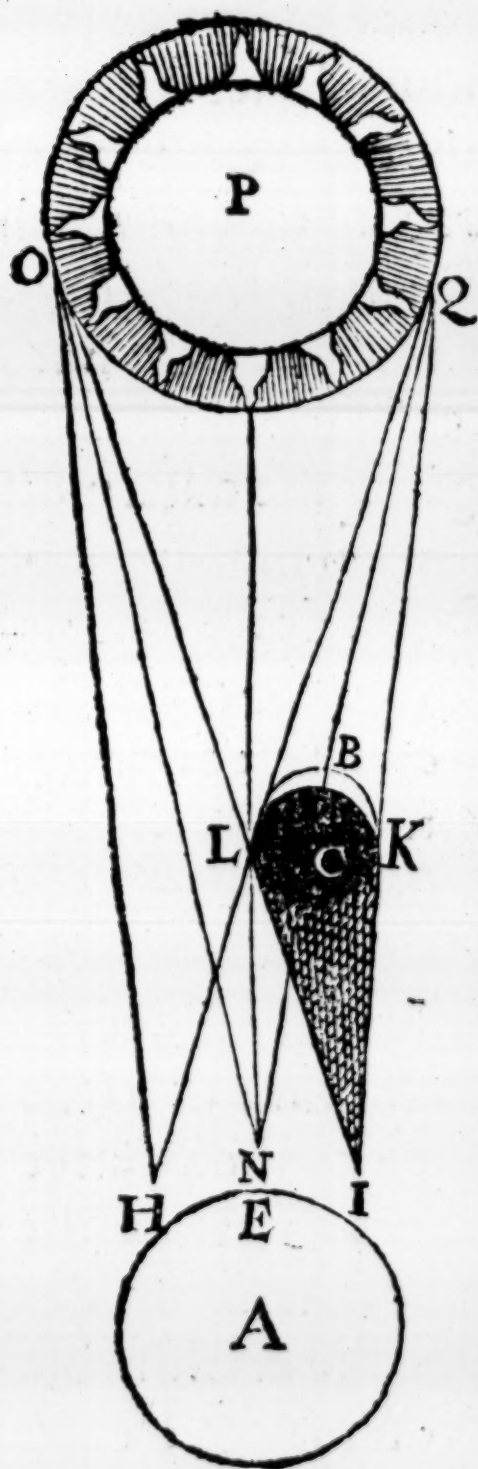


**T**His figure as you see consisteth of certaine circles, both greater and lesser, and of certain right lines: in which figure, the highest circle signifieth the bodie of the Sunne, whose centre is marked with the letter P: and the middle lesser circle beneath that, made most part blacke, signifieth the bodie of the Moon eclipsed, whose centre is marked with the letter C, and the diameter thereof is marked with the letters L K: and the lowest lesser circle representeth the bodie of the earth, whose centre is marked with the letter A: and the two great circles, crossing one another in two points opposit, that is to say, in C, where also would be set the character of the Dragons head; and in the other crosse point opposit, is set the character of the Dragons taile; of which two circles, the one is called the deferent of the Moon, and the other the Eclipticke. Now what the right lines doe signifie, the letters doe shew: for the two outermost right lines, F H, and G I, doe signifie the outermost beames of the Sunne, which doe fall vpon the earth: but the two inner lines F L, and G K, do signifie the beames of the Sunne which do fall vpon the Moone: which two lines being drawne out in length, do concurre and meet in the point A, representing the centre of the earth, and thereby doe make the cone to be F A G, the axletree of which cone, is the right line P A: and the little shadowed cone, marked with the letters L K A, signifieth the cone of the Moones shadow at the time of a true Conjunction, when the Sunne is eclipsed; the axletree of which little cone is signified by the line C A: and the two lines, K E, and L D, do signifie the outermost sides of the Moones shadow, falling vpon the earth in the two points D and E. Now hereby you may perceiue,



that those people which haue their dwelling betwixt D and E, are wholly deprived of the light of the Sun : but those that dwell betwixt E and I, or betwixt D and H, do still retaine the light of the Sunne. Moreover, the Sunne is to some inhabitants of the earth totally eclipsed, and to some partly, and to some nothing at all, as this figure next following doth plainly shew.

¶ *The second figure belonging to the Eclipse of the Sunne, with the description thereof.*



**T**His figure as you see consisteth of three circles and certaine right lines: of which circles, the highest and greatest representeth the body of the Sunne, whose centre is marked with P : and the middle little circle, made almost all blacke, signifieth the body of the Moone, whose centre is marked with the letter C, and her semidiameter with C B, and her whole diameter with L K, and the small vpper portion of her bodie, made white, is that which is lightened by the Sunne, all the rest of her bodie beeing darkened. The third and lowest circle being greater than that of the Moone, signifieth the body of the earth, whose centre is marked with A, and the semidiameter thereof with A E.

Now

Now as touching the signification of the right lines, the letters thereto belonging doe shew : for the outermost lines marked with Q K, and O L, doe signifie the outermost beames of the Sunne that doe fall vpon the bodie of the Moone, concurring or meeting in the point I, enclosing the Conicall shaddow of the Moone, marked with the letters L K I, the axletree of which Conicall shaddow is the middle line C I, for to those that dwell vpon the earth vnder the point I, the Sunne is totally eclipsed, and to those that dwell vnder the point N, he is partly eclipsed, and partly not, and to those that dwell betwixt N and H, he is not eclipsed at all. Againe, the Moone is not alwaies right vnder the Eclipticke line, as the Sunne is, and therefore her shaddow at the time of the Eclipse cannot point to the centre of the earth, as it doth when she is in either of the two Nodes: but sometime Northward and sometime Southward from the centre of the earth, according as her latitude is either Northerly or Southerly : so likewise her said shaddow after euery true Conjunction will point Eastward, and before a true Conjunction Westward.

And further you haue to note, that the true and visible Conjunctions doe neuer happen together, except the true Conjunction of the Sunne and Moone chance to be in the 90 degree, which what it is, is before declared, for in the 90 degree there is no Parallax at all. But in all other places, the true and visible places doe differ, and the visible Conjunction is before the true Conjunction, if the said true Conjunction be in the East part of the Zodiacke, that is, betwixt the Sunne rising and the 90 degree. But if the true Conjunction be in the West part of the Zodiacke, that is, betwixt the 90 degree and the  
Sunne



Sunne setting, then the true Conjunction is before the visible Conjunction. And generally, the further that the true Conjunction is from the 90 degree, the greater is the difference betwixt the true Conjunction and the visible Conjunction, which things are before fully declared, whereas I speake of the Parallax, and by help of the celestiall globe are easily perceiued.

*Of the varietie of the Solar Eclipses, and why they be not alwaies like, but doe differ as well in magnitude as in time of continuance.*

**O**F this varietie there be foure causes.

1. First, the vnequall apparent latitude of the Moone: for the greater that the latitude of the Moon is, the lesser and shorter is the Eclipse of the Sunne: but the lesser that her latitude is, the greater and longer is the Eclipse of the Sunne. For this is a generall true rule, that if the apparent latitude of the Moone at the time of the visible Conjunction be greater than the summe of the two semidiameters of the Sun and of the Moone, being both added together, then the Sunne shall not be eclipsed at the visible Conjunction: but if the apparent latitude of the Moone be lesse than the summe of the two said semidiameters, being added together, then shall the Sunne be eclipsed at that visible Conjunction: and the greater that the difference betwixt the summe of the two semidiameters, and the Moones latitude is, the greater is the Eclipse of the Sunne.

2. The second cause of the varieties of the Eclipse of the Sunne, is the vnequall distance as well of the Sunne as of the Moone, from the earth: for the changing of  
their

their distances from the earth, maketh the diameters of their bodies to appeare greater or lesser. For the neerer that they approach to the earth, the greater do their diameters appeare vnto vs: for when the Sunne is in the Auge of his Excentrique, and therewith in his greatest excentricitie, the semidiameter of his shadow is  $\frac{1}{1}, \frac{11}{40}$ . But if he be in his greatest excentricitie, and in the opposit Auge of his Excentrique, then his semidiameter is  $\frac{1}{1}, \frac{11}{2}$ , which is greater than it was before by  $\frac{1}{1}, \frac{11}{2}$ . And if the Sunne be in his least excentricitie (as it is almost in these our dayes) and also in his Auge, then his semidiameter is  $\frac{1}{1}, \frac{11}{49}$ , but being in the opposit Auge of his Excentrique, then his semidiameter is  $\frac{11}{6}, \frac{1}{2}$ , which is greater than it was before by  $\frac{1}{1}, \frac{11}{3}$ . Likewise, when the Moone is in her Auge, whether it bee at her Coniunction with the Sunne, or at her Opposition to the Sunne, her semidiameter is but  $\frac{1}{1}, \frac{11}{50}$ , but being in her opposit Auge, her semidiameter will be  $\frac{1}{1}, \frac{11}{49}$ , which is greater than it was before by  $\frac{1}{1}, \frac{11}{49}$ . whereby it happeneth, that sometime the whole bodie of the Sunne seemeth to be darkened, and at other times but some part of his bodie, and that either at some side thereof, or els in the very middest of his bodie, and then there appeareth round about him a narrow bright circle, which we commonly call a borrough, all the other part in the midst of his body being darkened.

3. The third cause of the varietie of the Solar Eclipses, is the twofold inequality of the Moones motion, whereof the first dependeth vpon the motion of her Epicycle, whereby she is sometimes swift, and sometimes slow of gait. And the second inequality of her motion happeneth by reason of her Parallax, which maketh her moti-



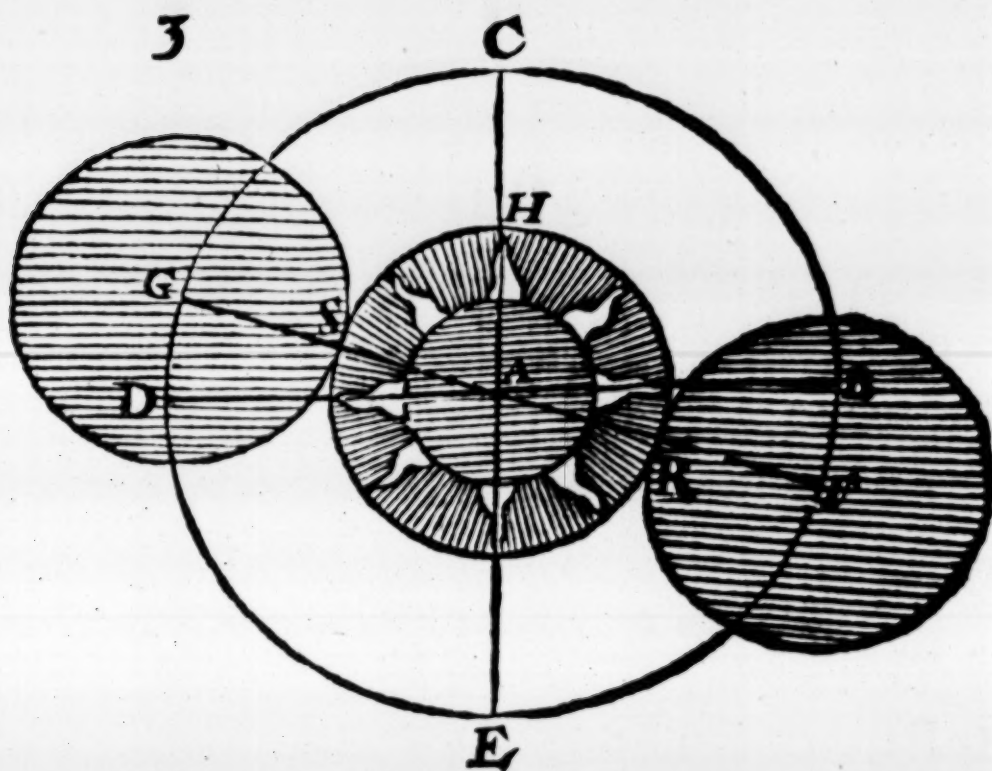
on to appeare variable euery houre, and thereby her apparent motion is also sometime swift & sometimes flow. And it happeneth, that not onely the time of the continuance of the Eclipse altereth, but also the time of Incidence is made to be vnequall vnto the time of repletion.

4. The fourth cause of the inequality of the Sunnes Eclipses, is the small quantitie of the body of the Moon, in respect of the Sunne, or of the Earth, and the small distance of the Moone from the Earth: for by these two meanes neither can the Solar Eclipses appeare of a like bignesse in all places in which they may be seene, neither yet can the said Eclipses be seene at one time in all places of the earth, as was shewed before. Lastly, by these two meanes it happeneth that the Eclipse of the Sunne appeareth not at one selfe time in diuers places, and it be- ginneth sooner to them which dwell Westward, than to those which dwell Eastward, in such sort, as the said Eclipse of the Sunne will be ended in one place before it begin in another. And thus much touching the causes of the varietie of the Eclipses of the Sunne.

*Of the two speciall kinds of Solar Eclipses, that is, totall and partiall.*

**T**He Totall Eclipse is when the Sunne is wholly darkened, or seemeth to vs to haue lost his whole light, and this Eclipse is alwaies without continuance, which happeneth when the Moone hath no apparent latitude at the time of the visible Conjunction, as this figure plainly sheweth.

¶ The third figure belonging to the Solar Eclipse.



**I**N which figure, suppose the letter A to be the centre of the Sunnes body, and the line A H to bee the semidiameter of his body, and D B to be the Eclipticke line, and A B to be the semidiameter of the circle, in which the Moone is at the beginning and ending of the Eclipse, and the line F G to be the way of the Moones motion, during the time of the Eclipse, crossing the line D B in the point A, which point A may also signifie the head or taile of the Dragon, and the letter F signifieth the South latitude, and G the North latitude: and the point F doth also signifie the centre of the Moone at the beginning, and G the centre of the Moone at the ending of the Eclipse, and the line R F or G S doth signifie the semidiameter of the body of the Moone. Now you see, that the Moone by her motion commeth by little and little

D d ij

to



to shaddow the light of the Sunne vntill she haue mooued from the point F, where the Eclipse began, vnto the point A, where his whole light is taken away; and then without any stay she moueth on forward from the point A vnto G, where the Eclipse endeth. And although it falleth out sometimes, that the Moone dooth shaddow more than the body of the Sun (which is very seldome or neuer, although it may so happen) yet doth the totall darkenesse continue so little a time, as it is insensible: and therefore the totall Eclipse of the Sunne is alwaies without continuance.

*Of the Partiall Eclipse of the Sunne.*

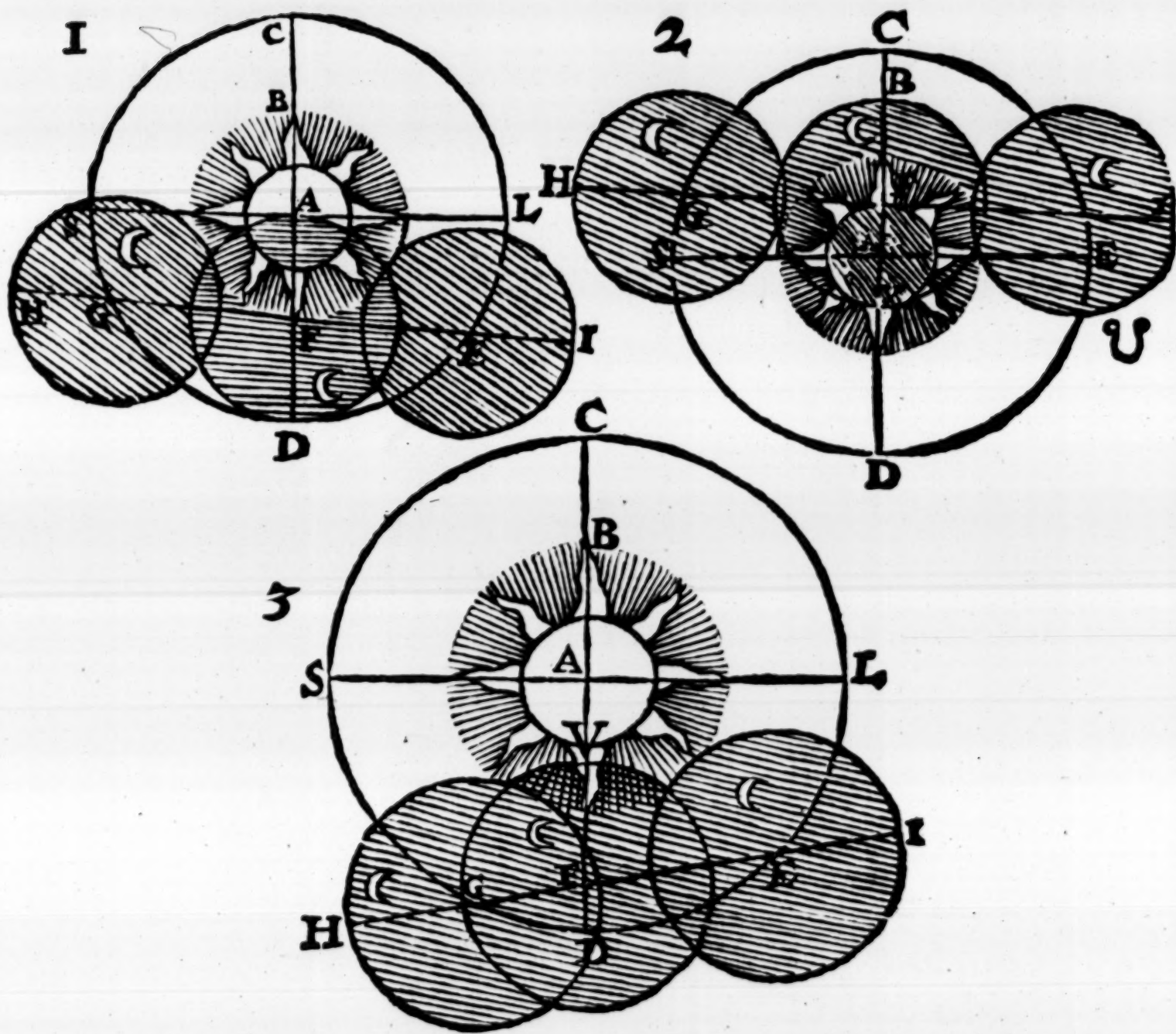
**T**He Partiall Eclipse of the Sunne is when some part of the Sunnes light is taken away, and not all his bodie darkened; and of this kind there are three sorts.

1. The first is, when the semidiameter of the Sunne is darkened: which happeneth when the apparent latitude of the Moone is equall vnto her apparent semidiameter.

2. The second sort is when more than the semidiameter of the Sunne is darkened, which happeneth when the apparent latitude of the Moone is lesse than the apparent semidiameter of her bodie.

3. The third, is when lesse than the semidiameter of the bodie of the Sunne is darkened, which happeneth when the apparent latitude of the Moon is greater than the apparent semidiameter of her bodie. Of all which three kinds, I haue set an example in these three figures here following.

¶ Three figures shewing the three kinds of the Sunnes  
Partiall Eclipses.



Of which figures, the first sheweth the first kind of  
Partiall Eclipse, the second figure sheweth the  
second kind, and the third figure sheweth the last  
kind of Partiall Eclipses. In euery of which figures, the  
letter A signifieth the centre of the Sunne, and the se-  
midiameter of his bodie is the right line A B, and vpon  
D d iij the



the centre A is drawne a great circle, marked with the letters C S D L, whereof the letter C signifieth the North, D the South, L the West, and S the East: vnto which circle when the Moone commeth on the West part, the Eclipse of the Sunne beginneth; and it endeth when the Moone commeth to the said circle on the East side. And the right line S L signifieth the Eclipticke line, and the right line H I signifieth the deferent of the Moone: and the point marked with the letter E, signifieth the place of the Moone at the beginning of the Eclipse, and G her place at the ending of the Eclipse, and F her place at the middle of the Eclipse, or at the time of her greatest darkenesse: and the right line F V in the second figure is the semidiameter of the Moone at the time of her greatest darkenesse. The characters of the Nodes on the East or West side of any of the foresaid figures doe shew what way the head or taile of the Dragon doth stand, and to which of the Nodes the Eclipse is nearest.

*Of the bounds or limits of the Solar Eclipses.*

**A**Nd now that you know the seuerall kinds of Eclipses, it will not be hard to judge which of them will happen at the time of any Eclipse of the Sunne, especially if you know the bounds or limits within which the Eclipse of the Sunne must needs be before hee can bee eclipsed: which bounds cannot bee better determined, than by the apparent latitude of the Moone; for if the said latitude be more than the two semidiameters of the Sunne and of the Moone being both added together, it is impossible that the Sunne should be eclipsed at that  
Con-

Conjunction: but if the apparent latitude be lesse than the said two semidiameters, then may the Sun be eclipsed: and the least summe of the two semidiameters of the Sunne and Moone that can be (which is when both the Sunne and Moone are in the Auges of their orbes, and the Sunne in his greatest excentricitie) is  $\frac{1}{30} \cdot \frac{11}{40}$ . and the greatest summe of the said two semidiameters that can be, is but  $\frac{1}{4} \cdot \frac{11}{51}$ . from hence you may gather these three rules here following.

1. First, if the apparent latitude of the Moone at the time of the visible Conjunction be lesse than  $\frac{1}{30} \cdot \frac{11}{40}$ . it cannot be but that the Sunne must be eclipsed.

2. Secondly, if the apparent latitude of the Moone at the time of the visible Conjunction be more than  $\frac{1}{30}$ .  $\frac{11}{40}$ . and lesse than  $\frac{1}{4} \cdot \frac{11}{51}$ . it may bee that the Sunne shall be eclipsed in some part at the time of the visible Conjunction.

3. Thirdly, if the apparent latitude of the Moone be more than  $\frac{1}{4} \cdot \frac{11}{51}$ . the Sun cannot loose any of his light. But *Ptolomey* determineth the said bounds of the Solar Eclipses by the distance of the Moone from either of the two Nodes: for if the Moon be distant from either of the Nodes 20 degrees,  $\frac{1}{40}$ . towards the North, or 11 degrees,  $\frac{1}{20}$ . towards the South at the time of the meane Conjunction, then it may fall out that the Sunne shall be eclipsed: but if she be further distant from the said Nodes at the time of the meane Conjunction, then cannot the Sunne be eclipsed. And note, that *Ptolomey* maketh the North bounds bigger than the Southerne bounds, because of the Parallax. And this distance from the Nodes may be reckoned either according to the succession or contrarie to the succession of the signes.

of



*Of the Eclipticall digits belonging to the Solar Eclipses.*

AS the Eclipticall digits of the Moone were 12, so likewise are there 12 Eclipticall digits of the Eclipse of the Sunne; but the Eclipse of the Sunne can neuer exceed 12 digits and 15 minutes: for the greatest apparent semidiameter of the Moone is but  $17^{\circ} 49'$ . and the least apparent semidiameter of the Sunne is  $15^{\circ} 40'$ . which two semidiameters if you adde together, the summe will be  $33^{\circ} 29'$ . Then hauing doubled the least semidiameter of the Sunne, which is  $15^{\circ} 40'$ . the summe will be  $31^{\circ} 20'$ . which is the least apparent semidiameter of the Sun: then say by the rule of proportion, if  $31^{\circ} 20'$ . be equall to 12 digits, to what or how much shall  $33^{\circ} 29'$ . be equall? so shal you find the fourth proportionall number to be very neare 12 digits and 50 minutes: and this is the greatest number of Eclipticall digits that any Eclipse of the Sunne can haue. And this may happen when the Sunne is in the Auge of his Excentrique, and in his greatest excentricitie: and the Moone in her opposit Auge, and therewith in such places as are situated within the compasse of the Moones shaddow, the diameter of which shaddow may at that time be very neare 280 miles in length of our English miles, or 70 Germane miles, within which compasse whosoever dwelleth, may loose the whole light of the Sunne at that Eclipse. And you shall know the number of the Eclipticall digits by the 62 precept of the Prutenicall tables. And many times it may fall out, that although the Moone haue no apparent latitude, yet the Eclipse of the Sunne will not be so great, for if the Moon  
be

be in her Auge, and the Sunne in the opposit Auge of his Excentrique, and therewith in his least excentricitie, the number of the Eclipticall digits can be no more but 11 degrees, and 15 minutes, so as the Sunne will appear to haue lost his light in the very midst; and round about that Eclipse will appeare a little circle as it were three quarters of an inch in breadth. All which things touching the Eclipticall digits, will not be hard to conceiue, if you remember what was spoken of this matter in the Eclipses of the Moone.

*What things are to be considered touching the continuance of the Solar Eclipse.*

**I**N accounting the continuance of the Eclipse of the Sunne, the Astronomers doe only obserue two things.

1. The first is the scruples of Incidence, which are nothing els but the way or arch of the circle of the Moones deferent, in which she goeth from the beginning of the Eclipse vnto the middle of the same: which in the three last figures is signified by the line E F.

2. The second thing which they vsually obserue, is the time of Incidence, which is nothing els but the quantitie of time which the Moone spendeth whilest she is in going of the said minutes of Incidence: both which two things you shall easily find, as also the minutes of repletion, by the 63 precept of the Prutenicall tables. And as the Eclipse of the Moone doth begin on the East side of her bodie and endeth on the West side thereof, euen so the Eclipse of the Sunne beginneth on the West side of his bodie, and endeth on the East; which happeneth by the motion of the Moone, which motion is from

E e

West



West to East: and if the Eclipse of the Sun be partiall, and the apparent latitude of the Moone be North, then is the North side of the Sunne eclipsed, and the South side retaineth still his light: but if her apparent latitude be South, then is the South side of the Sunne darkened, and the North side keepeth still his light. And this is a generall obseruation, that no Eclipse of the Sun is vniuersall (except that which was against nature at the death of Christ) but alwaies perticular, that is, it may be scene in some few places, but not in all places of the world: neither doth it begin or end in all places at one selfe instant, neither dooth it appeare in all places of one selfe bignesse, or of one shape, but in one place is totall, and in another place at the same time Partiall, and in other places againe there appeareth no Eclipse at all. The causes of which diuersitie haue been before declared.

*How to find out the quantities, encreasing, decreasing, beginning, and ending of the Suns Eclipses, without any offence of your eyesight.*

**H**Auing learned by the Ephemerides, or by some other Almanacke at what time the Eclipse shall be, resort to some tower or high loft, the higher the better, and see that the place whereas you would make your obseruation, be without light, and so darke, as you can possibly make it, leauing only a litle hole or rift, through which the beames of the Sunne may streeke through: and vpon the pauement or on the wall that looketh right against that hole or rift, behold what light the Sunne yeeldeth, for that light will represent the true shape of the Sunne at that present, and plainly shew so much

much portion to be wanting from the lightsome circle, as the Moone comming betwixt the Sunne & the earth, doth take away from our sight. Wherefore if you deuide the diameter of the said lightsome circle into 12 parts or points, which the Astronomers doe call digits, you shall find out all the things aboue mentioned, without looking vp to the heauen.

*The Methodicall doctrine of the Eclipses, set downe by  
Reinoldus in his Commentarie vpon Purbachius.*

**F**irst *Ptolomey* found out the true latitude of the Moone, and deuided the same from her apparent latitude, as he teacheth in the 12 chapter of his fift booke: for in the Eclipses of the Moone it is very necessarie to haue knowledge both of her true latitude, and also of her apparent latitude, for the Eclipse of the Sunne without hauing knowledge of her apparent latitude, and of her Parallaxes, can neuer be well foreknowne: and by this he did not only judge of other things, but also by a Geometricall way found, that the greatest distance of the Moon from the earth, she being either at the change or at the full, did contain 64 semidiameters of the earth, and one sixt part. Moreouer, by other obseruations hee did know the proportions of the semidiameters, as well of the Moones excentrique, and of her Epicicle, as also of her excentricitie. Then by other obseruations hee sought out the quantities of the apparent diameters of the Sunne, of the Moone, and of the shaddow, as well at the new Moone, as at the full, in manner and forme following: for first by the helpe of an instrument, hauing a Dioptr, he found the Sunne and Moone to be in one  
E c ij selfe



selfe angle when shee was most distant from the earth. Then he attributed to the Moone two Eclipses, in the one whereof, when her latitude was  $\frac{i}{48} \cdot \frac{ii}{30}$ . the shaddow darkened one quarter of her diameter: and in the other Eclipse, the shaddow darkened the one halfe of her diameter, when as her latitude was  $\frac{i}{40} \cdot \frac{ii}{40}$ . and in either of the Eclipses the Moone was very nigh to the height of her Epicicle. Hereof it manifestly appeared, that a quarter of the Moones diameter, when she was most distant from the earth, contained in heauen according to our aspect,  $\frac{i}{7} \cdot \frac{ii}{0}$ . which being reckoned foure times, doe shew that the diameter of the Moone was at that time  $\frac{i}{31} \cdot \frac{ii}{20}$ . whereunto the obserued diameter of the Sunne was then equall: and the semidiameter of the shaddow in the later Eclipse did appeare to be  $\frac{i}{40} \cdot \frac{ii}{40}$ . for the centre of the Moones body did then touch the outermost brim of the shaddow. Hereby it likewise appeareth, that the diameter of the shaddow hath such proportion to the diameter of the Moones body, as 13 hath to 5, and keepeth the selfe-same proportion in all other Eclipses of the Moone: and though it most manifestly appeareth by this, that the diameter of the shadow doth exceed in greatnesse the diameter of the Moone, yet it followeth not by & by thereof, that the Moone is lesser than the earth. Now therefore *Ptolomey* by comparing according to the doctrine of plaine triangles, the semidiameters of the Moone and of the shadow together with the distance of the said Moon, being measured by the semidiameters of the earth, hee found the semidiameter of the Moone only to containe  $\frac{i}{17} \cdot \frac{ii}{3}$ . and the semidiameter of the shaddow to containe  $\frac{i}{45} \cdot \frac{ii}{38}$ . such like minutes, I say, as the semidiameter of the earth hath 60. And therefore it appeareth hereby, that

that either of the semidiameters, that is, of the Moon, or of the shadow, is lesse than the semidiameter of the earth: for the semidiameter of the earth is almost in like proportion to the semidiameter of the shadow, as 4 is to 3, and being compared to the semidiameter of the Moone, it is almost in such proportion, as 17 is to 5: whereof it followeth necessarily, that the shadow of the earth is Conicall, that is, round, growing to a sharpe point, and therefore the Sunne must needs be greater than the earth. Neither could any right judgement haue been made touching the quantities of the said three bodies, that is, the Sunne, the Moone, and the earth, vnlesse that the Parallaxes of the Moone had first shewed the distance of the Moone from the earth, the said distance being measured by the semidiameters of the earth. For if you suppose the distance betwixt the Moone and the earth to be 48 semidiameters of the earth, you shall find that the semidiameter of the shadow will be altogether equall to the semidiameter of the earth, and so the shadow shall be Cylindricall, that is to say, in all parts round like a pillar. And if you suppose the said distance of the Moone from the earth to be greater, as to be 170 semidiameters of the earth, then the semidiameter of the shadow (the Moone being in *Transit*) will contain two semidiameters of the earth, and so the shadow shall be Calathoidall, that is to say, like a cup or top, extending together with his length in breadth and widenesse more and more infinitely. All which three shapes of shadows are before plainly set forth in their figures. By this *Ptolomey* doth proue, that the distance of the Sun from the centre of the earth, containeth 1270 semidiameters of the earth, and that the semidiameter of the Suns bodie



containeth five such semidiameters and a halfe, as the earth hath, and that the diameter of the Sun to the diameter of the earth is in such proportion as is 11 to 2. Finally, he proueth the axletree of the shadow to contain 268 such semidiameters as the earth hath. Wherefore according to the opinion of *Ptolomey*, the excentricitie of the Sunne should containe 48 semidiameters of the earth, and almost one fourth part. Now by knowing the diameters of the three bodies, it is easie to find out their proportions: for by the last proposition of *Euclide* his twelfth booke, looke what proportion is betwixt the diameters of any two spheres, the same proportion beeing tripled, is the proportion betwixt the said two spheres. And therefore because the diameter of the Sunne is to the diameter of the earth in like proportion, as 11 is to 2, the same proportion being tripled, shall be 1331 to 8, so as the body of the Sunne doth containe the body of the earth 166 times and almost one halfe. In like maner you shall find the bodie of the Moone to be almost the 40 part of the body of the earth: for the diameter of the earth to the diameter of the Moon is in such proportion as is 17 to 5, so as the body of the earth containeth the body of the Moone almost 40 times, as was said before. And the body of the Sunne containeth the bodie of the Moone almost 6600 times. The proportions of which three bodies are these numbers here following, that is to say, for the Sunne 6539203, and for the Earth 39304, and for the Moone 1000.



A breefe Extract of *Maginus* his  
 Theoriques, shewing all the definitions of such  
 names and motions as are needfull to be knowne for the  
*calculating of the places of any of the seven Planets, or*  
*other motions of any Heaven whatsoever, that*  
*are to be found out by the Prutenicall Tables.*



To auoid the Paradoxicall supposition  
 of *Copernicus*, supposing the Earth to  
 mooue, and the Sunne to stand still in  
 the midst of heauen, *Maginus* is  
 faine to suppose that there be three mo-  
 uable heauens aboue the eight heauen,  
 and so maketh in all eleuen mouable heauens, which is  
 one more than all the other Astronomers haue hereto-  
 fore set downe. And he calleth the highest or eleuenth  
 heauen, the first mouable, describing the same as hereaf-  
 ter followeth: next to which is placed in his Theoriques  
 the tenth heauen, then the ninth and eight heauen, and  
 vnder that, the seven Planets, that is, first Saturne, then  
 Iupiter, Mars, Sol, Venus, Mercurie, and Luna, which is  
 the lowest heauen of all. Of which his Theoriques I  
 thought good to make a breefe Extract, because that  
 more tearmes belonging to the Prutenicall Tables are  
 therein both defined and demonstrated, than are set  
 downe either by *Purbachius* or by *Messlelyn* in their The-  
 oriques.



oriques. And according to the number of this eleuen Heauens, I haue deuided this Extract into 11 chapters.

### CHAP. I.

*The description of the eleuenth Heauen or first mouable, together with such definitions as are contained therein.*

**T**He first mouable is the greatest or highest heauen, which carieth all the inferior heauens round about from East to West in 24 houres. The concaue superficies whereof is imagined to be traced with certaine circles, whereof some be greater and some lesser.

2. The greater circles cheefely seruing for our purpose, are these, the *Æquinoctiall*, the *Eclipticke*, and the two *Colures*, the one called the *Colure of the Equinoxes*, and the other the *Colure of the Solstices*.

3. The *Æquinoctiall* is a great circle supposed to be in the convex superficies of the first mouable, deuiding the same superficies into two equall parts, the poles of which circle are the poles of the world, vpon which poles the said first mouable continually mooueth, making his reuolution in 24 houres.

4. The *Eclipticke* of the first mouable is also a great circle, deuiding the superficies thereof into two equall parts, & cutteth the *Æquinoctiall* in two opposit points, which points are called the *Equinoxes*, one of them being called the *Vernall Equinox*, and the other the *Autumnall Equinox*: and the poles of this *Eclipticke* are alwaies distant from the poles of the world 23 degrees,  $\frac{1}{2}^{\circ}$ . and doe neuer alter. And this *Eclipticke* is called the *meane Eclipticke*.

5. The *Colure of the Equinoxes*, is a great circle  
passing

passing through the two Equinoxes, and the two poles of the world.

6. The Colure of the Solstices, is also a great circle deuiding the superficies of the first moouable into two equall parts, and is drawne both through the poles of the world, and also through the poles of the meane Eclipticke.

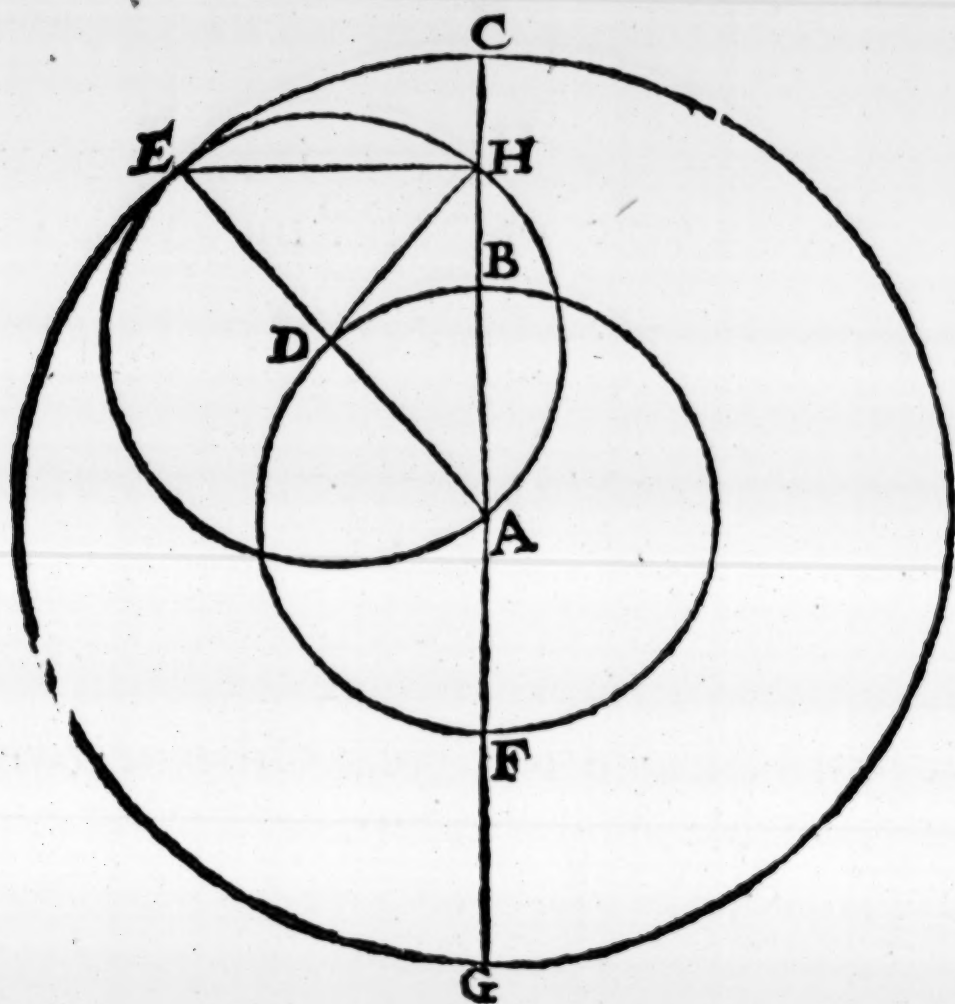
## CHAP. II.

### *Of the tenth Heauen.*

**T**He tenth Heauen is a great Orbe next vnto the first mouable, hauing contrarie motion to the first moouable, that is, from West to East vpon the poles of the Eclipticke of the first moouable or meane Eclipticke, and maketh his reuolution in 3434 Ægyptian yeares, and 10 daies.

2. In this heauen are imagined to be described such like greater circles, as are before described in the first mouable: for the Æquinoctiall of this heauen and the two Colures are in one selfe plaine, right vnder the Æquinoctiall and Colures of the first moouable: but the Eclipticke of this heauen is mouable, by reason of the vnstabilitie of the poles of the Eclipticke of the said tenth sphere: for the better vnderstanding of which vnstabilitie, *Maginus* setteth downe this figure.





In which, imagine the letter A to be the pole of the meane Eclipticke of the first moouable, and also the pole of the tenth heauen, about which pole the tenth sphere maketh his reuolution in 3434 Ægyptian yeares, and 10 daies. And vpon the point A imagine also a lesser circle to be drawne, whose semidiameter is A B, containing in length  $\frac{1}{2}$ . and imagine the same lesser circle to be the circle B D F, in the circumference whereof, suppose the centre of another lesser circle equall to that, to be placed in the point D, and let the semidiameter of the said second lesser circle be D E, containing in length  $\frac{1}{2}$ . the centre of which second circle, *viz.* D, you must suppose neuer to change his place, but to mooue about the pole A, as the tenth heauen mooueth about the same pole A. And so likewise suppose the second little circle A H E to be fastened to the first, so as the said  
second

second circle hath no other motion but that which the centre D hath, and imagine the right perpendicular line C G to be part of the Solsticiall colure of the first mo- uable; which Colure the circumference of the second little circle A H E will cut in some one point or other, as in the point H, the place of which intersection where- soeuer that happeneth vpon the line C G, is the pole of the Eclipticke of the tenth heauen, whose pole doth con- tinually alter his place, and therefore the place of the Eclipticke of the said tenth heauen, must needs alter, be- ing sometimes farre from the meane Eclipticke, and sometimes neare vnto it, and sometimes vnited there- with. But the greatest distance that can be betwixt the two Ecliptickes, is  $1\frac{1}{2}$ . according to the greatest distance which is betwixt the poles of the Eclipticke, & the poles of the first moouable: for the poles of the Eclipticke of the tenth heauen can neuer exceed  $1\frac{1}{2}$ . and the Ecliptick of this tenth heauen is called the true Eclipticke, whose poles doe differ from the poles of the meane Eclipticke  $1\frac{1}{2}$ . as haue been said before.

3. And such distance is called the equacion of the ob- liquitie of the Eclipticke, which the former figure doth plainly demonstrate: for the letter A is supposed to be the pole of the meane Eclipticke, and H the pole of the true Eclipticke: and this equacion of the obliquitie is to be found in the 16 Cannon of the Prutenicall tables, by helpe of which equacion or Prosthapherisis, you may find at any time the obliquitie of the true Eclipticke, as is taught in the 13 precept of the said tables. But now be- cause the said Prosthapherisis cannot bee found but by the Anomalia of the obliquitie, you are to know first what that Anomalia is, which the foresaid figure dooth



also shew. In which figure, you must suppose the right line A E to be the diameter of the second lesser circle, the one end whereof is alwaies fixed in the point A : and the other end marked with E, by the motion of the tenth heauen, describeth the great circle C E G.

4. And this circle is called the circle of Anomalia of the obliquitie of the true Eclipticke.

5. And the arch or portion of this circle, marked with the letters C E, is the Anomalia of the obliquitie of the true Eclipticke : the motion of which Anomalia you shall find at any time by the Prutenicall tables in the 14 Cannon vnder the title *Anomalia Æquinoctiorum* in such order as the eight precept teacheth.

### CHAP. III.

#### Of the ninth Heauen.

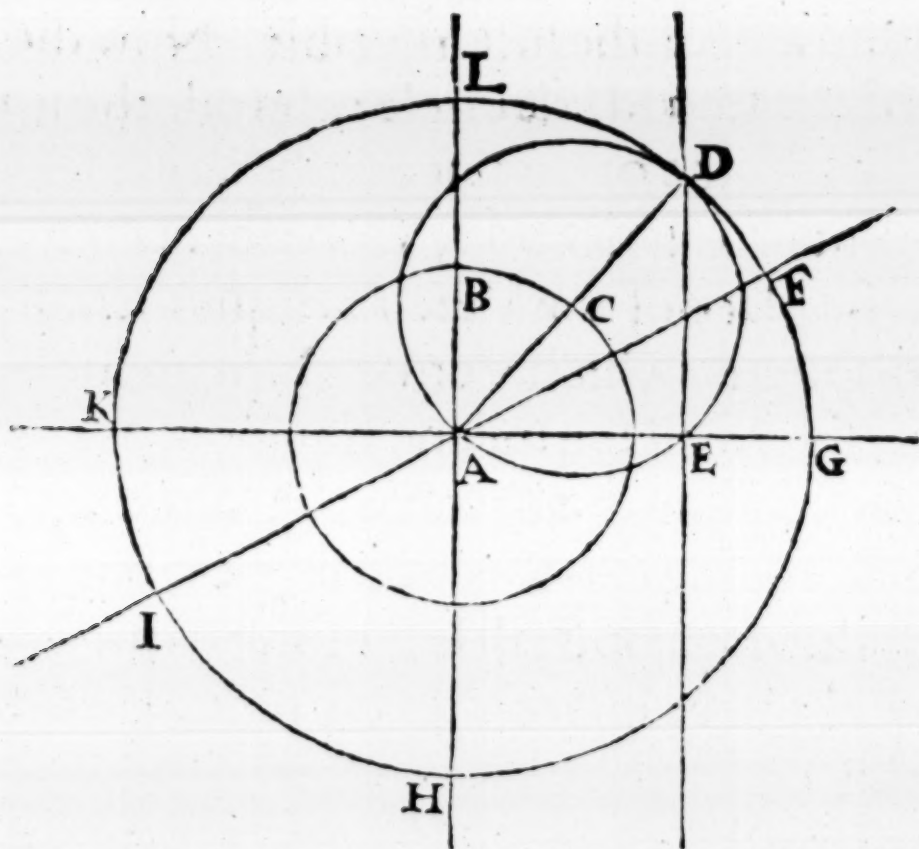
**T**He ninth Heauen is a sphere situated next and immediately vnder the tenth heauen : the motion of which ninth sphere is from North to South vpon his proper poles, which are fixed in the two Æquinoctiall points, called the true Æquinoctiall points of the tenth heauen, about which poles he maketh his reuolution in 1717 Ægyptian yeares and 5 daies.

In this sphere are imagined certaine circles both greater and lesser to be drawne, as in the former two hea- uens: but the greater circles whereof we shall haue most vse, are these, that is, the Eclipticke and the Æquinoctiall.

2. The Eclipticke of this ninth sphere is alwaies in the plane of the Eclipticke of the tenth sphere, and therefore doth not differ from the true Eclipticke, because it neuer swarueeth from the same : but the Æquinoctiall  
line

line of this ninth sphere is mouable, according as the two *Æquinoctiall* points in which it crosseth the true *Eclipticke*, are mouable, being caried both backward and forward, and sometimes are conjoined together with the *Æquinoctiall* points of the tenth heauen, and sometimes againe are remooued from the said true *Æquinoctiall* points of the tenth sphere, and the greatest distance that the said two points can haue from the *Æquinoctiall* points of the tenth sphere is 1 degree, <sup>i</sup><sub>11</sub> . <sup>ii</sup><sub>22</sub> . <sup>iii</sup><sub>30</sub>°.

The motion of which *Æquinoctiall* points, and also of the sphere it selfe, you shall more easily vnderstand by this figure here following.



**I**N which, the point A signifieth the Vernall *Æquinoctiall* point, as well of the tenth heauen, as of the first mouable, which point we will hereafter call the true vernall *Æquinox*, in which point one of the poles of the ninth sphere is supposed to be fixed, and the other pole

F f iij

is



is in the opposit point, which is the true Autumnall *Æ*-quinoctiall point. Now vpon the centre A imagine a little circle to be drawne, whose semidiameter is A B, containing in length vpon the superficies of the said ninth sphere,  $\frac{i}{35} \cdot \frac{ii}{41} \cdot \frac{iii}{15}$ . and in the same convex superficies imagine a second little circle to be drawne, equall vnto the former, the centre of which second circle is in the circumference of the first little circle, *vi*z. in the point C, the semidiameter whereof is C D, containing in length  $\frac{i}{35} \cdot \frac{ii}{41} \cdot \frac{ii}{15}$ . so shall the whole diameter A D containe in length 1 degree,  $\frac{i}{11} \cdot \frac{ii}{22} \cdot \frac{iii}{30}$ . and suppose the right line K G to be the true Eclipticke, and the right overthwart line I F to be the *Æ*quinoctiall line of the tenth heauen and also of the first mouable. Now the circumference of the second little circle wil crosse the true Eclipticke K G in some one point or other, as in the point E, which point of Interfection, wheresoeuer it happeneth to be, is the place of the Vernall *Æ*quinoctiall point of the ninth sphere: which Vernall *Æ*quinoctiall point we will henceforth call the meane Equinox, as the point A is the true Equinox. So that hereby you may perceiue, that the meane Equinox is nothing els but that point in which the *Æ*quinoctiall line of the ninth sphere crosseth the Eclipticke line of the said ninth sphere or true Eclipticke.

3. The Prosthapheresis of the Equinox is the distance which is betwixt the true and meane Equinox, as is the line A E: and this Prosthapheresis you shall find in the 16 Cannon, vnder the title *Præcessionis Æquinoctiorum*, the manner of finding whereof is taught in the 10 Precept. But because the said Prosthapheresis cannot bee found but by helpe of the Anomalia of the Equinox.

4. I will therefore shew what the said Anomalia of the Equinox is. For the vnderstanding whereof, resort to the former figure, in which you see how the tip or extreame point of the diameter of the second circle, *viz.* the point D describeth by his motion, that is, by the motion of the ninth sphere, the circle D F G H I K L, which circle is called the circle of Anomalia, wherein the motion of the Anomalia is alwaies reckoned: and the distance betwixt the point L and the point D, is the Anomalia of the Equinox it selfe, and is alwaies double vnto the Anomalia of the obliquitie of the true Eclipticke, and therefore we vse to doe no more but to double the Anomalia of the said obliquitie, otherwise called the simple Anomalia, which is to be found by the 14 Cannon, vnder the title, *Anomalia Æquinoctiorum*, in such order as the eight Precept teacheth.

CHAP. IIII.

☿ *Of the eight Heauen.*

1. **T**He eight Heauen is situated vnder the ninth Heauen, and moueth from West to East contrarie to the motion of the first moouable, vpon the poles of the true Eclipticke, making his revolution in 25816 Ægyptian yeares, and dependeth wholly vpon the meane Equinox.

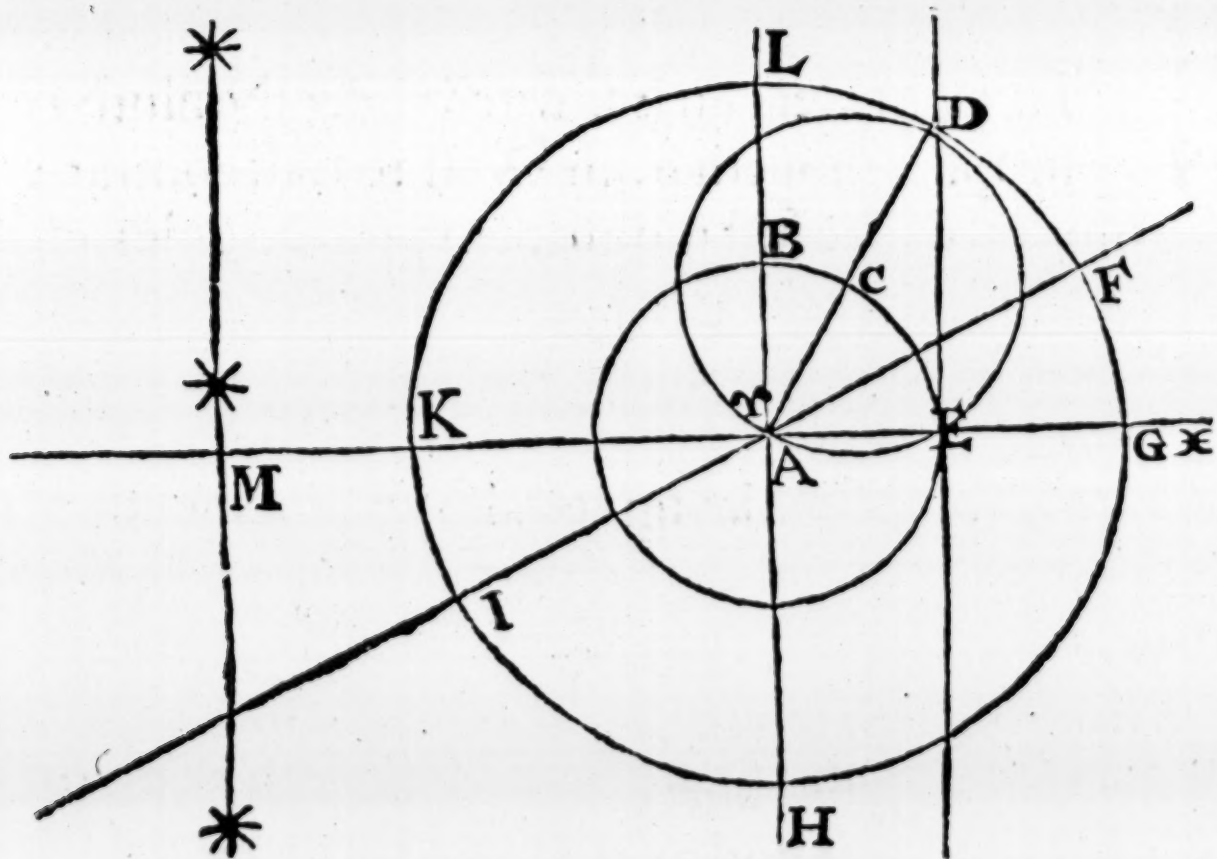
2. In this sphere are imagined also an Æquinoctiall and an Ecliptick line: and the Ecliptick line of this Heauen is alwaies in the same plane with the Ecliptick of the 9 and 10 Heauens, and swarueh not from the true Ecliptick at all. But the Æquinoctiall points of this sphere do moue from the true Equinoxes, sometimes forward, and sometimes



times backward, euen as the meane Equinox of the ninth sphere moueth.

3. This sphere is apparent to the eye, by reason of the multitude of starres which are therein: the moouing of all which starres, and all other the inferior lights, is accounted or reckoned from the first starre of the Rams horne, as from a visible beginning, although the same be vnstable, by reason of the changeable moouing of the Precession of the meane Vernall Equinox.

4. The Precession of the Equinox is a portion of the true Ecliptick, comprehended betwixt two great circles, whereof the one passeth through the first starre of the Rams horne, and the other through the Equinox; which if it be the true Equinox, then the arch of the Eclipticke, comprehended betwixt the two said circles, is called the true Precession: but if it passe through the meane Equinox, then it is called the meane Precession of the Vernall Equinox.



As

As for example, suppose in this figure the line K G to be the true Eclipticke, and I F to be the *Æquinoctiall* of the first moouable, crossing one another in the point A, which representeth the true Equinox, vnto which point when the Sunne commeth, it is Equinox throughout all the world: and suppose M to be the first star of the Rams horn, through which a right perpendicular line passeth, signifying a great circle drawne through the first starre of the Rams horne, & also through the poles of the true Eclipticke: and suppose L H to be another great circle drawne through the true *Æquinoctiall* point A, and through the poles of the true Eclipticke, so shall M A be the true Precession of the Vernall Equinox. In like manner suppose the line D E to be another great circle, passing through the point E, signifying the meane Equinox, and also through the poles of the true Eclipticke, so as the arch of the true Eclipticke, which is comprehended betwixt M and E, is the meane Precession of the vernall Equinox. And this meane Precession is readily found by the 14 Cannon, as the 8 Precept teacheth, and the title thereof in the said 14 Cannon, is *Precessionis Æquinoctiorum*. But the true Precession is to be found by helpe of the Prosthapheresis, which was defined in the third definition of the third chapter.

And although that there be many other circles both great and little, which the Astronomers vse, as the circles of Positions, Azimuths, and many others, yet will I only speake of such circles, arches, and points in the Heauen as are belonging to our present purpose (because I haue spoken of the others in my sphere) shewing what is the longitude, latitude, and declination of any star or point in this Heauen.



5. The longitude of any starre is an arch of the Eclipticke, comprehended betwixt the true Vernall Equinox, and the circle of latitude of the said starre or point.

6. The circle of latitude is a great circle passing through the poles of the true Eclipticke and the centre of the starre. Of which circle, that part which is betwixt the centre of the starre and the true Eclipticke, is called the latitude of the starre.

7. The circle of declination is a great circle, passing through the poles of the world, and through the centre of any starre or other point in the firmament: and that part of this circle which is contained betwixt the said starre and the true Æquinoctiall line, is called the declination of the starre.

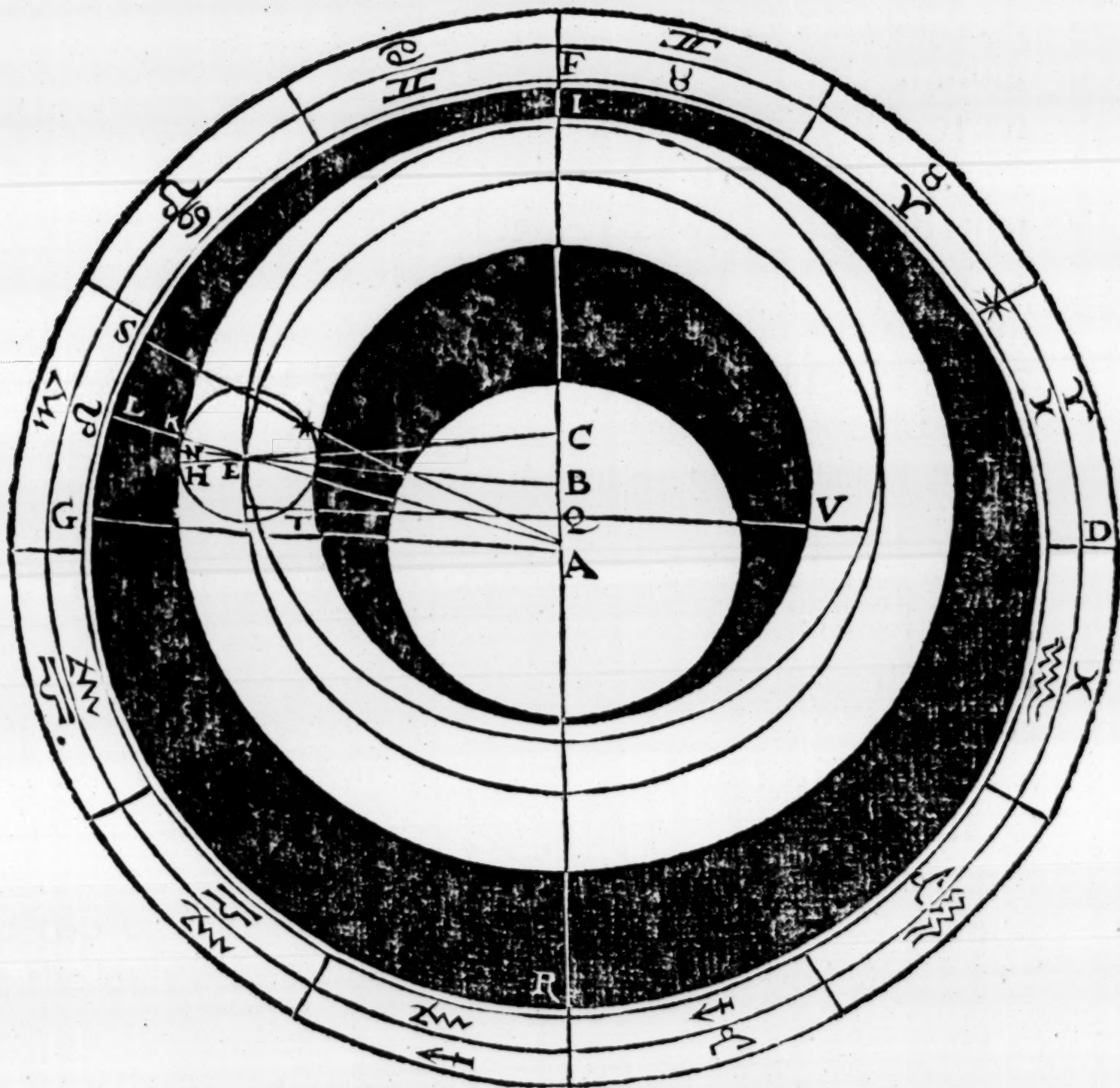
#### C H A P. V.

*Of the seventh Heauen, that is, the heauen of Saturne.*

1. **T**He seventh Heauen is situated next vnder the eight Heauen or Sphere, and mooueth from West to East, and is onely proper to Saturne, which is the highest Planet: whole orbes and motions thereof, this figure here following doth plainly shew.

*The*

¶ The first figure belonging to the Theorique of Saturne,  
together with the description thereof.



In this figure, consisting of certain circles & right lines,  
you see that the three outermost great circles drawn vpon  
the point A, signifying the centre of the world, do enclose  
two white feuerall spaces, and in each space are set down

G g ij

the



the characters of the 12 signes: of which two spaces, the outermost representeth the Eclipticke both of the 10 and 9 Heauen, the beginning of which Ecliptick is marked on the right hand with the letter D, signifying the true Vernall Equinox: and the next space vnder that representeth the Eclipticke of the eight Heauen, whose beginning is marked with a little starre, signifying the first starre of the Rams horne.

2. And the two blacke orbes doe represent the deferents of the Auge, which Auge is marked with the letter I, & the opposit Auge with the letter R, which deferents doe moue regularly, and doe make their reuolution in 35333 Ægyptian yeares: and betwixt the two blacke orbes is another white orbe, signifying the orbe Excentrique, drawne vpon his owne centre, marked with the letter B, in the midst of which broad white circle is another circle described by the centre of the Epicicle, marked with the letter E, vpon which point E is drawne a little circle, signifying the Epicicle it selfe, which carrieth the body of the Planet, in the circumference wherof is a little starre, representing the body of Saturne. You see also that there is another circle which crosseth the foresaid middle circle of the Excentrique in two points opposit, drawne vpon his owne centre, marked with C, and is called the circle Equant. The motions of which circles, and also the significations of the right lines and arches in this figure contained, are by helpe of the letters hereafter declared: for the right line which is drawne from the point A vnto the point I, and so forth to the Eclipticke, is called the line of Auge: and the point or degree of the Eclipticke, into which the line of the Auge falleth, is called the place of the Auge, which for example

ple sake suppose to be in the first point of Gemini, marked with the letter F. And the arch comprehended betwixt the point F and the first starre of the Rams horne, signified by the little starre set downe on the right hand in the true Eclipticke is called the meane motion of the Auge. And the right line A B is called the excentricitie of the Excentrique, containing in length 3 degrees,  $\frac{1}{2}$ ; and the right line A C is the excentricitie of the circle Equant, containing in length 6 degrees,  $\frac{1}{2}$ .

3. The Auge is that point in the superficies of the Excentrique which is furthest distant from the centre of the world, marked with the letter I. But the opposit Auge is that point in the superficies of the said Excentrique, which is nearest vnto the centre of the world, marked with the letter R.

4. The place of each point is shewed by a right line drawne through the centre of the world & also through the Auge of the Excentrique vnto the Zodiacke of the eight Heauen, marked with the characters of the twelve signes, and the line so drawne, is called the line of Auge.

5. The meanemotion of the Auge is an arch of the Eclipticke, proceeding from the first starre of the Rams horne vnto the place of the Auge, and is found in such order as is shewed in the eight Precept, by helpe of the 13 and 14 Cannons in that Colume, whose title is *Apo-gea Saturni*.

6. But the true motion of the Auge is an arch of the Eclipticke, beginning at the true Vernall Equinox, and ending at the place of the Auge: the manner how to find the same, is shewed in the 33 Precept.

7. The orbe Excentrique, is an orbe of one equall thicknesse, compassing the centre of the world, in which



Excentrique the Epicicle is alwaies caried, and maketh his reuolution in 29 Ægyptian yeares, 183 dayes, and almost 5 houres, the Diurnall motion thereof is  $\overset{i}{1} \overset{ii}{0} \overset{iii}{21}$ . almost.

8. The centre of the Excentrique, marked with B, is a point in the middle of the Excentrique, from which all right lines that are drawn vnto the concauitie of the Excentrique, are equall.

9. The distance betwixt which centre and the centre of the world is called the excentricitie of the Excentrique: and the distance betwixt the two said centres, that is, of the world and of the Excentrique, is 3 degrees,  $\overset{i}{2}$ .

10. The circle Equant is a circle described vpon the point C in the plane of the Excentrique, in regard of the centre wherof, the motion as well of the Excentrique as of the Epicicle, is regular and equall. And this circle is sometimes called the circle of equalitie, sometimes the Equator, and other times the Excentricall Equator, the distance of the centre wherof is from the centre of the Excentrique 3 degrees,  $\overset{i}{2}$ , and from the centre of the world 6 degrees,  $\overset{i}{0}$ . and this distance from the centre of the world is called the Excentricitie of the circle Equant.

11. The Epicicle is a little orbe, whose centre is marked with the letter E, which the Excentrique carrieth about, which Epicicle notwithstanding hath his proper motion, for the higher part thereof hath his moouing according to the succession of the signes, and the lower part contrarie to the succession of the signes. The daily motion of the Epicicle about his owne centre, is  $\overset{i}{57} \overset{ii}{7} \overset{iii}{44}$ . and maketh one entire reuolution in 378 dayes, 21 houres,  $\overset{i}{36}$ .

But

12. But because that the accounting of the motions by the circle Equant is troublesome, therefore the Astronomers doe vse to reckon the same vpon the Eclipticke, by supposing a line to be drawne from the centre of the world vnto the Eclipticke, in such sort, as the same may be paralel vnto the line before drawne: as in the foresaid figure, the line A G being paralell vnto the line C E, is called the line of the meane moouing of the Epicicle or of the Planet.

13. The meane Anomalia of the Excentrique is an arch of the Ecliptick, beginning at the line of the Auge, and so proceeding according to the succession of the signes, vntill it end at the line of the meane moouing, as in the foresaid figure the line A F is the line of the Auge, and A G is the line of the meane moouing. Now the arch of the Eclipticke, which is comprehended betwixt the two lines, A F, and A G, that is to say, the arch F G is called the meane Anomalia of the Excentrique, and of some it is called the meane or equall centre.

14. But if the said arch bee reckoned from the first starre of the Rams horne, vnto the line of the meane moouing, marked with A G, then the said arch is called the equall motion of longitude, which you may find by the Tables at any time, supposed by the 13 and 14 Canons in the Colume, whose title is *Longitudinis Saturni*, in such order as is shewed in the eight Precept.

The equall or meane moouing of the longitude of Saturne, is daily  $\frac{1}{2} \cdot \frac{2}{0} \cdot \frac{3}{27} \cdot \frac{4}{18}$ . and the yearely motion thereof is 12 degrees,  $\frac{1}{12} \cdot \frac{2}{46} \cdot \frac{3}{4}$ . and the whole reuolution is in 29 Ægyptian yeares, 174 dayes, 4 houres,  $\frac{1}{58} \cdot \frac{2}{29}$ . for in that time it returneth to the first starre of the Rams horne.



15. The line of the true mouing of the Epicicle is a right line drawne from the centre of the world, passing through the centre of the Epicicle vnto the Eclipticke, as in the foresaid figure the right line A E L is called the line of the true motion of the Epicicle.

16. The true or coequated Anomalia of the Excentrique (which is called by the *Alphonsines* the true centre) is an arch of the Eclipticke, beginning at the place of the Auge of the Excentrique, and endeth at the true place of the centre of the Epicicle, as in the foresaid Figure the arch F L is the true Anomalia of the Excentrique.

17. The true motion of the longitude of the Epicicle is an arch of the Eclipticke, beginning at the first starre of the Rams horne, and endeth at the true place of the centre of the Epicicle, as in the foresaid figure, the arch from the Rams horne, marked with a little starre in the Eclipticke of the eight sphere, to L, is called the true mouing of the longitude of the Epicicle.

18. The Prosthapheresis or Equacion of the centre, is the difference betwixt the meane Anomalia and the coequated Anomalia of the Excentrique, or the difference betwixt the equall mouing and the true moouing of longitude. As the arch L G is called the equacion of the centre, and this equacion is neuer greater than 6 degrees,  $\frac{1}{30}$ .  $\frac{11}{30}$ . and is alwaies greatest when the equall mouing of the centre of the Epicicle from the Auge of the Excentrique, is 11 Sex. 33 degrees, whether the same bee reckoned according to the succession of the signes, or contrarie to the succession of the signes: and from thence it decreaseth vntill the line of the said mean moouing commeth into the line of the opposite Auge.  
The

The finding of which Equacion is taught in the 34 Precept, by helpe of the 19 Cannon in the Colume, whose title is *Eccentrici*, and is to be added or subtracted according as the words *Subtrahere* and *Addere* at the head or foot of the said Colume, doe shew.

19. The two points in which the Prostapheresis of the Excentrique is greatest, are called the meane longitude of the Excentrique: and these two points are shewed by a right line perpendicularly drawne vpon the line of Auge, and passing through the middle space of the distance betwixt the centre of the world and the centre of the Excentrique, as in the former figure, in which the point A signifieth the centre of the world, and the point B the centre of the Excentrique. Now if the space B A be deuided into two equall parts, as in the point Q, and through the same point Q a right line be drawne, crossing the line A F with right angles, and is produced as well towards the right hand as towards the left, vnto the two points of the circumference of the Excentrique, marked with the two letters T and V, the said two points T and V are called the meane longitudes of the Excentrique: in which meane longitudes the centre of the Epicycle is, when the equall motion of Saturnes longitude is 93 degrees or 267 degrees.

20. The meane Auge of the Epicycle is a point in the circumference of the Epicycle, which is furthest distant from the centre of the circle Equant: and this point is found by drawing a right line from the centre of the circle Equant vnto the circumference of the Epicycle, through the centre of the said Epicycle, as in the former figure the right line C E being produced vnto the circumference of the Epicycle, sheweth the meane Auge  
H h of



of the Epicicle to be in the point H.

21. The true Auge of the Epicicle is a point in the circumference of the Epicicle, which is furthest distant from the centre of the world, and is found by drawing a right line from the centre of the world vnto the centre of the Epicicle, and produced vnto the circumference thereof, as the right line A E being produced vnto the circumference of the Epicicle, meeteth with the same circumference in the point K, which is therefore called the true Auge of the Epicicle.

22. The Touch-point is a point in the circumference of the Epicicle, which is furthest distant from the centre of the Excentrique, and is determined by a right line drawn from the centre of the Excentrique vnto the centre of the Epicicle, and so produced vnto the circumference of the Epicicle: as if the line B E bee produced vnto the circumference of the Epicicle, *viz.* vnto the point N, the said point N is called the Touch point of the Epicicle.

23. The Anomalia of commutation is an arch of the Epicicle, beginning at the meane Auge of the Epicicle, and ending at the place of the Planet in the Epicicle: and this arch is alwaies reckoned, according as the Planet moueth. As the arch H \* of the Epicicle is called the Anomalia of commutation, and is otherwise called of some the meane Anomalia of the orbe or Epicicle, and of others the meane argument: the finding of the Anomalia of Commutation is taught in the 8 Precept, by helpe of the 13 and 14 Cannons in his proper Column, whose title is *Anomalia comutationis Saturni*.

24. The coequated Anomalia of Commutation is an arch of the Epicicle, beginning at the true Auge of the  
the

the Epicycle, and ending at the place of the Planet in his Epicycle. As the arch K N H is called the coequated Anomalia of Commutation: which some call the true Anomalia of the Orbe, and others call it the true Argument.

25. The Prosthapheresis or equacion of the centre in the Epicycle, is an arch of the Epicycle, which is comprehended betwixt the meane and true Auge of the Epicycle: as in the former figure the point K is the true Auge, and the point H is the meane Auge of the Epicycle, the distance betwixt which two Auges is the arch K N H, and that is the equacion of the centre in the Epicycle: and this equacion is alwaies equall vnto the equacion of the centre, before defined in the 18 definition of this chapter: Only this rule is generally to be obserued, that if the Prosthapheresis were added in the coequating of the Anomalia of the Excentrique, the same Prosthapheresis must be subtracted in the coequating of the Anomalia of Commutation: and so againe if it bee subtracted in the former, then it must be added in the latter.

26. The line of the true motion of the Planet is a right line drawne from the centre of the world vnto the Eclipticke, through the centre of the Planet. As in the former figure the right line A \* S is called the line of the true motion of the Planet.

27. The true motion it selfe of the Planet is an arch of the Eclipticke, comprehended betwixt the true Vernal Equinox and the line of the true motion. As in the foresaid figure the arch D S is called the true motion of the Planet.

28. The equacion of the Argument, which *Copernicus* calleth the Parallax of the orbe, and others call the same

Hh ij

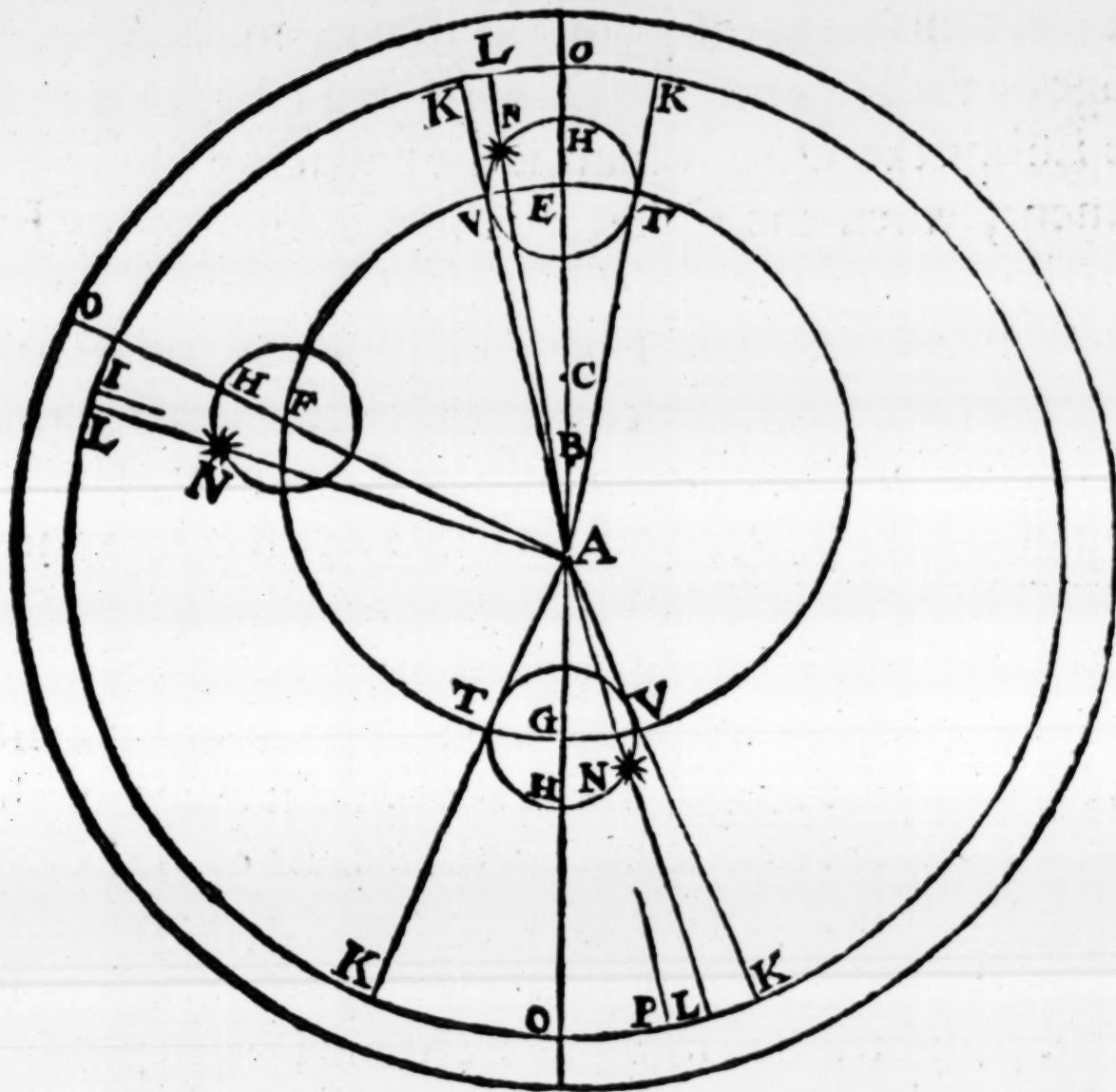
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the Prostapheresis of the Epicicle, is an arch of the Eclipticke, comprehended betwixt the line of the true motion of the Epicicle, and the line of the true motion of the Planet, as in the former figure the arch S L is the equacion of the argument. This equacion is found by helpe of the coequated Anomalia of Commutation, in such order as is shewed in the 34 Precept, and in the 19 Cannon in the Colume, whose title is *Paralaxis Orbis*. The greatest equacion that Saturne can haue, when the Epicicle is in the Auge of his Excentrique, and the Planet is distant from the Auge of the Epicicle 96 degrees, is 5 degrees,  $\frac{i}{5}$ .  $\frac{ii}{3}$ . But the greatest equacion belonging to him when the Epicicle is in the opposit Auge of the Excentrique, and the Planet is distant from the Auge of the Epicicle almost 97 degrees, is 6 degrees,  $\frac{i}{8}$ .  $\frac{ii}{8}$ .

29. The excesse of the equacion of the Argument, which the *Alphonsines* call the diuersitie of the diameter, is an arch of the Eclipticke, whereby the equacion of the Epicicle being in the opposit Auge of the Excentrique, exceedeth the laid equacion, when the Epicicle is in the Auge of his Excentrique. As you shall more plainly perceiue by this figure following.

In



In which figure, the middle point A signifieth the centre of the world, & B the centre of the Excentrique, and C the centre of the Equant. The middle circle marked with the letters E F G, signifieth the Excentrique, in which are placed three other little circles, signifying the Epicycles of Saturne, in euery of which circles the point H signifieth the Auge of the Epicycle, and O the true place of the Epicycle in the Eclipticke: and N signifieth the place of the starre in his Epicycle, and L his true place in the Eclipticke: and the arch O L the equacion of the argument, which equacion is least when the Epicycle is in the Auge of the Excentrique, marked with the letter E: but the said equacion is greater when the centre

H h iij

of



of the Epicycle is in the point F, and greatest of all when the said centre is in the point G, that is, in the opposit Auge of the Excentrique. Now if you take the arch of the Eclipticke O L, which is the equacion of the Argument, when the Epicycle is in the Auge of his Excentrique out of the arch O L (which is the equacion of the Argument) when the Epicycle is in the opposit Auge, the remainer wil be the arch P L, which remainer is called the excesse of the equacion of the Argument. The finding of which excesse is taught in the 34 Precept, by help of the 19 Cannon in the Colume, whose title is *Excessus*.

30. The proportionall minutes are the 60 parts of the excesse, by helpe whereof the equacions of the Epicycle, being not in the Auge, nor in the opposit Auge of the Excentrique are equated or corrected. As in the former figure the arch P L, which is the excesse, is supposed to be deuided into 60 equall parts, by helpe of which diuision the proportionall minutes are found in what place of the Excentrique soeuer the epicycle is placed. As suppose the true place thereof to be in the point F, in which situation of the Epicycle, the arch O L is the equacion of the Argument, which equacion is greater than it was when the Epicycle was in the point E, and the difference betwixt these two equacions is the arch I L. Now if you suppose the arch P L to bee deuided into 60 equall parts, looke how many of those parts the arch I L doth containe, so many proportionall minutes are belonging to the equacion of the argument of the Epicycle, when the place of the said Epicycle is in the point F. The finding of these proportionall minutes is taught in the 34 Precept, and are set downe in the 19 Cannon in the Colume, whose title is *Scrupula Proportionalia*.

31. The

31. The absolute equacion is an arch of the Eclipticke, which is compounded of the equacion of the Argument, and the excesse answerable vnto the proportionall minutes. And this absolute equacion is either added or subtracted vnto the true mouing of the Epicicle, and the summe of such addition or the remainer of the subtraction will shew the true distance of the Planet from the first starre of the Ramshorne: whereunto if you adde the true Precession of the Equinox, the summe of that addition will shew the true longitude of the Planet.

CHAP. VI.

*Of the sixt Heauen, or the Heauen of Iupiter.*

**T**He sixt Heauen, which is of Iupiter, consisteth of like orbes as doth the Heauen of Saturne, & therefore the demonstrations belonging to this Heauen, doe not differ from those which were set downe in the heauen of Saturne, but only in the time of their motions & in the quantitie of some arches: for the deferents of the Auge and opposit Auge in the heauen of Iupiter doe make their reuolution in 109756 Ægyptian yeares. And the Excentrique of this Heauen maketh his reuolution in 11 Ægyptian years, 318 daies, and one houre almost. And the excentricitie of the Excentrique of Iupiter is 2 degrees,  $\frac{1}{45}$ . and the excentricitie of the circle Equant is 5 degrees,  $\frac{1}{30}$ . The Epicicle of this Heauen maketh his reuolution in 398 dayes, 21 houres,  $\frac{1}{13}$ .  $\frac{11}{15}$ .  $\frac{11}{34}$ . and the daily motion thereof is  $\frac{1}{54}$ .  $\frac{11}{9}$ .  $\frac{11}{4}$ . The greatest equacion of the centre which belongeth vnto Iupiter, is 5 degrees,  $\frac{1}{13}$ .  $\frac{11}{9}$ . and that is when the centre of the Epicicle is distant from the true Auge of the Excentrique



trique 93 degrees, whether it be according or contrarie to the succession of the signes. And the greatest equacion of the Argument, when the centre of the Epicicle is in the Auge of the Excentrique, is 10 degrees,  $\frac{1}{3}^{\circ} \frac{2}{3}^{\circ}$  and then the distance of the Planet from the true Auge of his Epicicle, is 100 degrees,  $\frac{1}{3}^{\circ}$  almost. And the greatest equacion of the said Argument, when the Epicicle is in the opposit Auge of the Excentrique, is 11 degrees,  $\frac{1}{3}^{\circ} \frac{2}{3}^{\circ}$  & then the Planet is distant from the true Auge of the Epicicle 102 degrees almost.

The equall or meane moouing of Iupiters longitude from the first starre of the Rams horne, is daily  $\frac{1}{4}^{\circ} \frac{5}{9}^{\circ} \frac{8}{9}^{\circ}$  and the yearely motion thereof is 30 degrees,  $\frac{1}{19}^{\circ} \frac{11}{45}^{\circ} \frac{11}{6}^{\circ}$  & maketh one entire reuolution in 11 Ægyptian years, 214 dayes, 21 houres,  $\frac{1}{16}^{\circ} \frac{11}{24}^{\circ}$ .

The rest of the lines and arches belonging to this Planet, are defined in the former fift Chapter: and the finding of all such things as are needfull for that purpose are set downe in the said fift Chapter, differing nothing from the manner which was therein shewed, except it bee in the number of the Cannon, which for Saturne was the 19, and for this Planet it is the 20 Cannon.

#### CHAP. VII.

##### *& Of the fift Heauen, or Heauen of Mars.*

**T**He fift Heauen belonging to Mars, hath like number of orbes, as hath the Heauen of Saturne, and the said orbes are placed euen as they were in Saturne. And therefore I shall not need to make any particular relation of the orbes or lines of this sphere, but to referre you to the fift Chapter, shewing only here the diffe-

difference of the motions. The deferents of the Auge in the Heauen of Mars doe make their reuolution in 45088 Ægyptian yeares, so as their daily motion is  $\frac{iii}{4}$ . and their yearely motion is  $\frac{ii}{28} \cdot \frac{iii}{44} \cdot \frac{iiii}{37}$ .

The Excentrique of this Heauen maketh his reuolution in one yeare, and 322 daies almost, so as his daily motion is  $\frac{i}{31} \cdot \frac{ii}{26} \cdot \frac{iii}{26} \cdot \frac{iiii}{15}$ . and the yearely motion thereof is 191 degrees,  $\frac{i}{15} \cdot \frac{ii}{49} \cdot \frac{iii}{44} \cdot \frac{iiii}{3}$ .

The Epicicle of this Heauen maketh his reuolution in 2 yeares, 49 dayes, 19 houres,  $\frac{i}{43}$ . and the daily motion thereof is  $\frac{i}{27} \cdot \frac{ii}{41} \cdot \frac{iii}{40}$ . and his yearely motion is 168 degrees,  $\frac{i}{28} \cdot \frac{ii}{30} \cdot \frac{iii}{42}$ .

The greatest equacion of the centre belonging vnto Mars, is 11 degrees,  $\frac{i}{5} \cdot \frac{ii}{9}$ . and that is when the centre of his Epicicle is distant from the true Auge of the Excentrique 95 degrees and  $\frac{i}{30}$ . be it according or contrarie to the succession of the signes.

The greatest equacion of the argument, when the centre of the Epicicle is in the Auge of the Excentrique, is 36 degrees,  $\frac{i}{54} \cdot \frac{ii}{18}$ . and then the distance of the Planet from the true Auge of his epicicle is 127 degrees almost.

And the greatest equacion of the Argument, when the centre of the Epicicle is in the opposit Auge of his Excentrique, is 46 degrees,  $\frac{i}{38} \cdot \frac{ii}{4}$ . and that is when the Planet is distant from the Auge of the Epicicle 137 deg.

The meane mouing of the longitude of Mars is euery day  $\frac{i}{31} \cdot \frac{ii}{26} \cdot \frac{iii}{31}$ . and the yearely motion thereof is 191  $\frac{i}{15} \cdot \frac{ii}{18} \cdot \frac{iii}{29}$ . and maketh one entire reuolution in one yeare, 321 dayes, 23 houres,  $\frac{i}{32}$ .

All other lines and arches belonging to Mars are defined in the fift Chapter: and the Cannon seruing for the finding of them and their places, is the 21 Cannon in number.



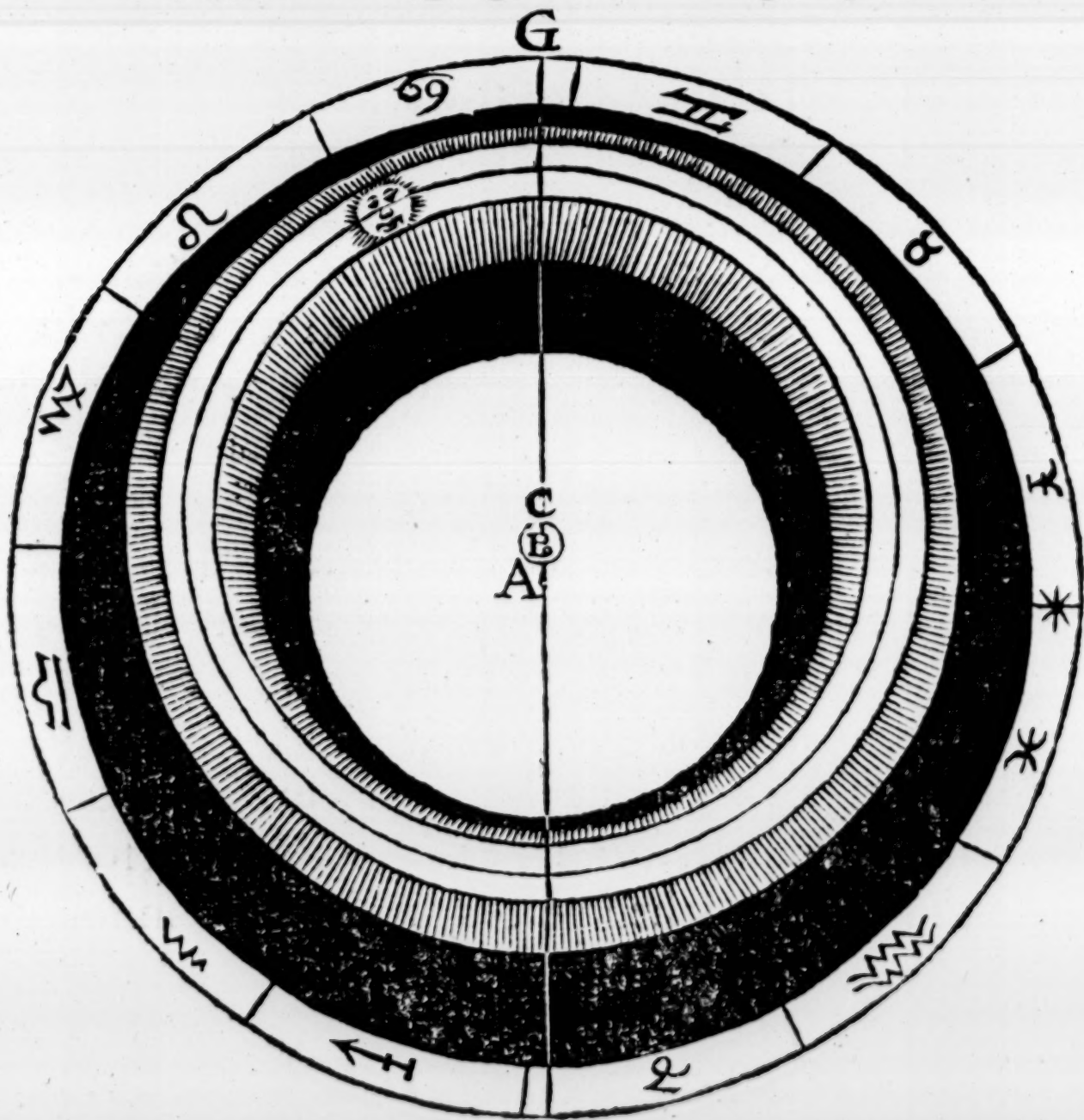
## CHAP. VIII.

## Of the fourth Heauen, or Heauen of the Sunne.

**T**He next Heauen vnder that of Mars, is the Heauen of the Sunne, and hath his proper and peculiar motion from West to East.

This Heauen consisteth of fiue orbes: wherof two are called the deferents of the meane Auge of the Suns Excentrique, the other two orbes are called the deferents of the true Auge of his Excentrique, or the orbes of the Anomalia of the true Auge and of the excentricitie of the Sunne. The fift Orbe is called the deferent of the body of the Sunne. All which you may evidently see in the figure following.

¶ The first figure belonging to the Theorique of the Sunne.



**I**N which figure, the outermost broad circle, in which are set the characters of the 12 signes, signifieth the Eclipticke of the eight Heauen, the centre whereof is marked with the letter A, which signifieth the centre of the world. Next vnto this Eclipticke is one of the deferents of the meane Auge signified by the outermost blacke orbe, the centre of whose convex superficies is the point A, and the centre of his concaue superficies is the point B, the other deferent of the said meane Auge is the lesser broad blacke circle, the centre of whose convex superficies is the point B, and the centre of his concaue superficies is the point A. And betwixt the blacke orbes are two shaddowed orbes, which are the deferents of the Sunnes Excentrique: and the convex superficies of the outermost of these two shaddowed orbes, as also the concaue superficies of the lower of them haue for their centre the point B, and the concaue superficies of the higher and convex superficies of the lower haue the point C for their centre. Betwixt which two orbes is the Excentrique of the Sunne, which Excentrique is signified by the broad white circle: in the middle of which white circle is drawne a circle, in which the centre of the Sunne is continually moued: and the centre of the Excentrique is marked with the letter C, which point is called the moouable centre of the Excentrique, by whose motion is described the little circle in the middle of the figure, the centre of which circle is the point B.

1. The deferents of the meane Auge of the Sunne are two orbes of vnequall thickeſſe, being in some respect concentricall with the Eclipticke, and in another respect excentricall: for the convex superficies of the higher, and the concaue superficies of the lower haue



for their centre the centre of the world, marked with A: but the concaue superficies of the higher, and convex superficies of the lower haue a centre differing from the centre of the world: and these two orbes haue their proper and peculiar motion from West to East vpon the axes and poles of the true Eclipticke, and their Diurnall motion is  $\frac{iii}{4} \cdot \frac{iiii}{12}$ . and their yearely motion is  $\frac{ii}{25} \cdot \frac{iii}{33} \cdot \frac{iiii}{12}$ . and do make one entire reuolution in 50717 Ægyptian yeares: and these two orbes doe only serue to carry the meane Auge of the Excentrique.

2. The meane Auge of the Excentrique is that point in the deferent of the Excentrique, which is furthest distant from the centre of the world. As for example, the point G in the former figure signifieth the meane Auge of the Excentrique.

3. And this point is alwaies determined in the Zodiacke by a right line, drawne from the centre of the world through the centre of the little circle, marked with B, vnto the Eclipticke line, and the line so drawne, is called the line of the meane Auge, as the line A B G, which is called the line of the meane Auge.

4. But the motion of the meane Auge is an arch of the Eclipticke, beginning at the first starre of the Rams horne, and ending at the line of the meane Auge, as in the said figure the arch \* G is the motion of the meane Auge: but if the said arch begin at the Æquinoctiall, whether the same be meane or true, then is the said motion called the motion of the mean Equinox, extending from the mean Equinox or from the true Equinox vnto the foresaid line of the meane Auge, the finding of eue-ry of which motions is shewed in the 16 Precept.

5. The deferents of the Excentrique, which some-  
times

times are called the orbes of the Anomalia of the excentricitie, are the two shaddowed orbes which do carry the orbe Excentrique. And these two orbes haue their proper motion also from East to West, making their revolution once in 3434 Ægyptian yeares, and 10 dayes, and their daily motion is  $\frac{1}{6} \cdot \frac{2}{17} \cdot \frac{3}{24} \cdot \frac{4}{9}$ . and their yearly motion is  $\frac{1}{6} \cdot \frac{2}{17} \cdot \frac{3}{24} \cdot \frac{4}{9}$ . And those deferents are moued vpon the centre of the little circle (which centre is marked with the letter B, and is distant from the centre of the world 2 degrees,  $\frac{1}{3}$ . such degrees as the length of the semidiameter of the Excentrique containeth 60 degrees) and their proper axletree is paralell vnto the axletree of the Eclipticke, and passeth through the centre of the said little circle, as the next figure following sheweth. And the motion of these orbes doth begin at the line of the mean Auge before defined in the third definition of this chapter. And it is called the Anomalia or Argument of the Auge, and of the excentricitie of the Sunne. By the motion of which Orbes the centre of the Excentrique is imagined to describe a little circle aboue the centre of the world, whereby the excentricitie of the Sunne changeth euery day.

6. The excentricitie of the Sunne is the distance betwixt the centre of the world and the centre of the Sun's Excentrique: and this is threefold, greatest, least, or meane.

7. The greatest excentricitie of the Sunne is when the centre of the Excentrique is in the Auge of the little circle, viz. in the point C, and the quantitie of this greatest excentricitie, is 2 degrees,  $\frac{1}{3} \cdot \frac{2}{9}$ . such like degrees as the semidiameter of the Excentrique containeth 60 degrees, or the quantitie of the said greatest excentricitie



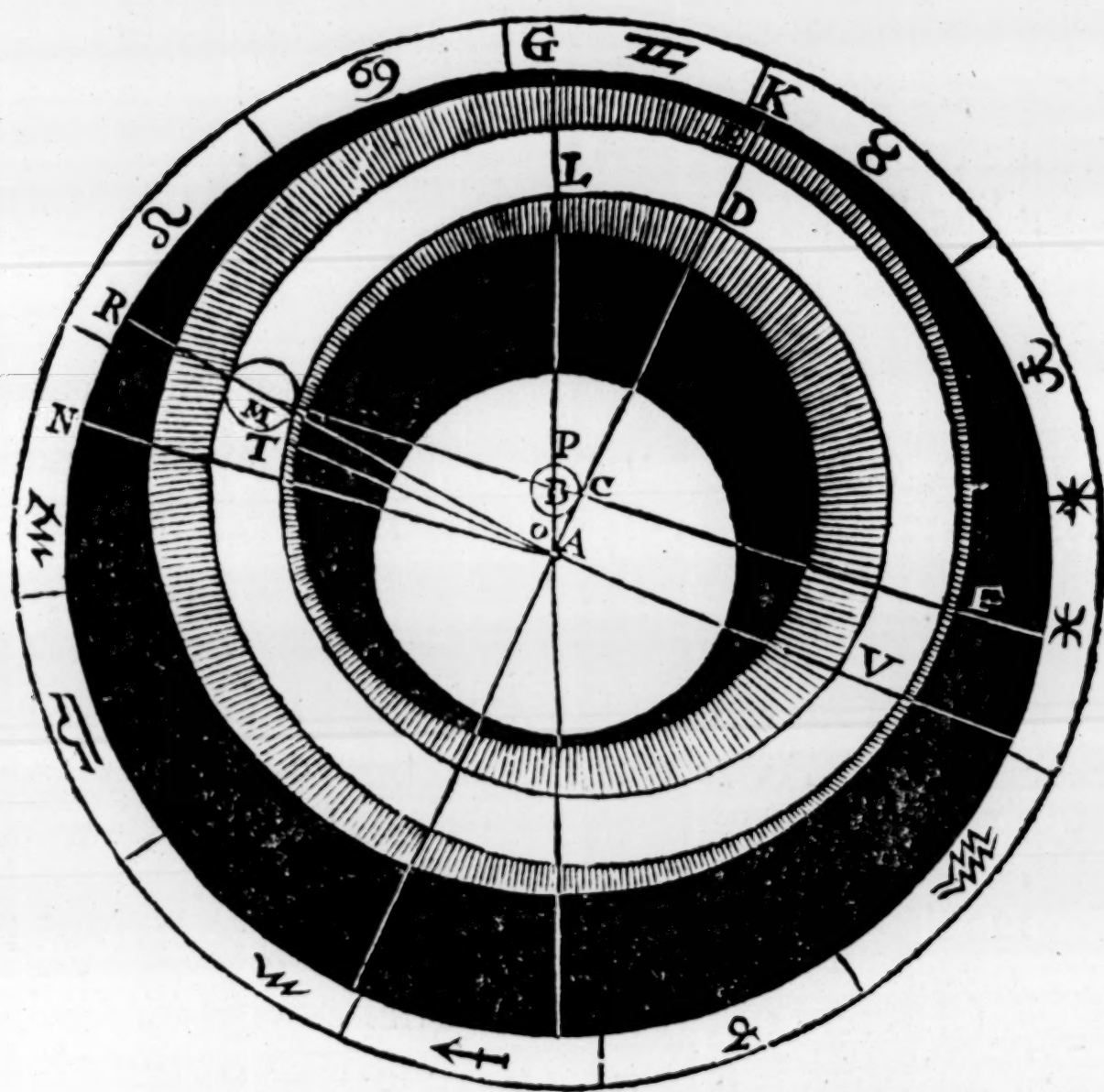
is 41700, when the semidiameter of the Excentrique is 1000000.

8. The least excentricitie is when the centre of the Excentrique is in the opposit Auge of the little circle, and then the distance betwixt the centre of the earth and the centre of the Excentrique, is 1 degree,  $\frac{1}{55} \cdot \frac{11}{53}$ . supposing the semidiameter of the Excentrique to be devided into 60 equall parts, but if the said semidiameter be devided into 1000000, then the said least excentricitie will be 32190.

9. The meane excentricitie is when the centre of the Excentrique is in the middle distance betwixt the Auge and opposit Auge of the little circle, and then the said excentricitie is 0 degrees,  $\frac{1}{34} \cdot \frac{11}{44}$ . such parts as the semidiameter of the Excentrique containeth 60. But if the said semidiameter bee supposed to bee devided into 1000000 parts, then the said mean excentricitie is 9510. And the semidiameter of that little circle containeth 0 degrees,  $\frac{1}{17} \cdot \frac{11}{7}$ .

10. The Anomalia of the Auge and excentricitie, which is also called the centre of the Sunne, is an arch in the concaue superficies of the outermost deferent of the meane Auge, which arch is comprehended betwixt the line of the meane Auge, and a right line drawn from the centre of the little circle through the mouable centre of the Excentrique vnto the concave superficies of the said outermost orbe. Or thus, the centre of the Sun is an arch of the little circle, beginning at the Auge of said little circle, and ending at the mouable centre of the Excentrique. As for example.

¶ *The second figure belonging to the Theorie of the Sunne.*



In this figure suppose the point A to be the centre of the world, and B the centre of the concave superficies of the outermost of the two deferents of the meane Auge, and C the centre of the Excentrique, whose place was sometimes in the point P, but now is gone from thence vnto C, so is A G the line of the meane Auge, and A P is the greatest excentricitie, and A O the least excentricitie, and P O is the difference betwixt the greatest and least excentricitie, the halfe whereof



whereof is B O, and A B is the quantitie of the meane excentricitie, and the place of the centre of the Excentrique is in the point C, and the arch G F is the Anomalia or Argument of the Auge and of the excentricitie in the concaue superficies of the highest deferent of the meane Auge, and the arch P C of the little circle is the Anomalia of the Auge and excentricitie: and the right line B C F is the line which sheweth the meane Auge of the orbes of the Anomalia of the Auge, in respect of their centre.

11. The meane Auge of the orbes of the Anomalia of the excentricitie, is that point in the concave superficies of the highest deferent of the Excentrique, which is furthest distant from the centre of the little circle, and is pointed out by a right line drawne from the centre of the said little circle, through the mouable centre of the Excentrique. As in this second figure, in which the point B is the centre of the little circle, and C is the centre of the Excentrique, through which point C if you draw a right line from A vnto the concauitie of the highest deferent of the Excentrique, as vnto the point E, the said point E is the mean Auge of the orbes of the Anomalia of the excentricitie. Now if you adde the daily mouing of this meane Auge, which is  $\frac{ii}{1} \cdot \frac{iii}{2} \cdot \frac{iiii}{2}$ . (as was said in the first definition of this Chapter) vnto the daily moouing of the meane Auge of the excentricitie, which is  $\frac{iii}{4} \cdot \frac{iiii}{12}$ . (as was said in the first definition of this Chapter) the summe of that addition will be  $\frac{ii}{1} \cdot \frac{ii}{6} \cdot \frac{iiii}{14}$ . and this is the daily distance betwixt the two meane Auges, viz. that of the excentricitie, and this of the orbes of the Anomalia of the excentricitie.

12. The orbe Excentrique is an orbe in the Theorique of

of the Sunne, in which the body of the Sunne is continually caried about. This orbe is placed betwixt the two orbes, which are the deferents of the Excentrique, and mooueth from West to East vpon his owne moouable centre (which centre is mouable, by reason of the moouing of the two orbes, which are the deferents of the Excentrique) and the axletree which is also mouable according to the motion of the centre of the Excentrique in the circumference of the said litle circle. And the daily motion of this orbe from the meane Auge of the orbes of the Anomalia of the excentricitie is  $\frac{i}{59} \cdot \frac{ii}{9} \cdot \frac{iii}{13} \cdot \frac{iiii}{24}$ . and maketh his entire reuolution in 365 dayes, 3 houres,  $\frac{i}{36} \cdot \frac{ii}{25}$ . which motion is reckoned from the meane Auge of the orbes of the Anomalia of the excentricitie. For the Sunne returneth to the said point or meane Auge in 365 dayes, 3 houres,  $\frac{i}{36} \cdot \frac{ii}{25}$ .

13. The line of the true place of the Sunne is a right line drawne from the centre of the world through the centre of the Sunne vnto the Eclipticke : and the point in the Eclipticke in which the said line endeth, is the true place of the Sunne. As in the former second figure, suppose the centre of the Sunne to be in the point M of the Excentrique, and hauing drawne a line from A to M, and so forth vnto the Eclipticke in the point R, the said line A R is called the line of the true place of the Sunne, and the point R is said to be the true place of the Sunne in the Eclipticke.

14. The yearly Anomalia of the Sunne, which is also called the meane Argument of the Sunne, is an arch of the Excentrique, which is comprehended betwixt the line of the meane Auge of the Excentrique, and the line of the true place of the Sunne. As in the foresaid second



figure the arch L M is called the yearely Anomalia of the Sunne.

Or thus, The yearely Anomalia of the Sunne is the excesse or difference, whereby the daily motion of the Sun from the mean Auge of the orbes of the Anomalia of the excentricitie, exceedeth the daily distance betwixt the meane Auge of the Excentrique, and the meane Auge of the orbes of the Anomalia: and this Anomalia is found by subtracting the daily distance of the said two Auges, which is  $\frac{ii}{12} \cdot \frac{iii}{6} \cdot \frac{iiii}{14}$ . (as was shewed in the 11 definition of this Chapter) out of  $\frac{i}{59} \cdot \frac{ii}{9} \cdot \frac{iii}{13} \cdot \frac{iiii}{24}$ . which is the daily motion of the Excentrique from the meane Auge of the orbes of the Anomalia of the excentricitie (as was shewed before in the 12 definition:) the remainder of which subtraction will be  $\frac{i}{59} \cdot \frac{ii}{8} \cdot \frac{iii}{7} \cdot \frac{iiii}{10}$ . And although that this Anomalia doth belong properly vnto the Excentrique: yet notwithstanding the said Anomalia is also supposed to be in the Eclipticke, by imagining a line to bee drawne from the centre of the world vnto the Eclipticke, in such order as that the said line may be paralell vnto another line which is drawne from the centre of the Excentrique vnto the place or centre of the Sun: and the line so drawn, may be called the line of the Imaginarie motion of the Sun. As in the foresaid second figure let a right line be drawn from C to M, then vnto the same line draw another paralell right line from the centre A, and produce the same vnto the Eclipticke in the point N; so shall the arch of the Eclipticke, which is comprehended betwixt the points E and N, bee the yearely Anomalia or meane Argument of the Sunne in the Zodiacke. The finding of which Anomalia for any time appointed, is taught in the 8 Precept, by helpe of the 13  
and

and 14 Cannons in that Collum, whose title is *Anomalia annua Solis.*

15. The true Auge of the Excentrique is that point in the Excentrique which is furthest distant from the centre of the world. And this true Auge is pointed or shewed by a right line drawne from the centre of the world through the moouable centre of the Excentrique vnto the Eclipticke, and the point in the Eclipticke, in which the said right line doth end, is the place of the true Auge of the Excentrique in the Eclipticke: and the said right line is called the line of the true Auge of the Excentrique: as in the foresaid second figure the point A signifying the centre of the world, and the point C the centre of the Excentrique, in the superficies of which Excentrique the point D is furthest distant from the centre A, and therefore the point D is the true Auge of the Excentrique: and the right line A C D is called the line of the true Auge of the Excentrique: and the point K in the Eclipticke, in which the said line endeth, is the place of the true Auge in the Eclipticke, the finding whereof is taught in the 16 Precept.

16. The motion of the true Auge of the Excentrique is an arch of the Eclipticke, beginning at some principall point in the Eclipticke, and ending at the line of the true Auge of the Excentrique: which principall point if it be the first starre of the Rams horne, then is the said motion called the moouing of the true Auge from the first starre of Aries: and if the said motion or arch doth begin at the true Equinox, then is the said motion called the moouing of the true Auge from the true Equinox.

17. The equacion of the centre is an arch of the  
K k ij Eclipticke,



Eclipticke, which is comprehended betwixt the meane Auge of the outer blacke orbes, and the true Auge of the Excentrique, as in the foresaid second figure of this Chapter, the arch K G in the Eclipticke is called the equacion of the centre: and this equacion neuer exceedeth 7 degrees,  $\frac{i}{23}$ ,  $\frac{ii}{36}$ . the manner of the finding of which equacion is shewed in the 15 Precept, by helpe of the 17 Cannon in that Colume, whose title is *Centri*.

18. The true Argument of the Sunne, which is also called the equated yearly Anomalia, is an arch of the Ecliptick, which is contained betwixt the line of the true Auge of the Excentrique, and the line of the Imaginarie motion of the Sunne. As in the foresaid second figure the line A K is the line of the true Auge of the Excentrique, and the place of the said true Auge in the Eclipticke is the point K. Likewise the line A N is the line of the Imaginarie motion of the Sunne. Now the arch of the Eclipticke, which is contained betwixt the 2 points K and N, is called the true Argument or equated Argument of the Sunne. For the difference betwixt the mean and true Arguments of the Sunne, is also the difference which is betwixt the meane and true Auge of the Excentrique, which difference is called the equacion of the centre before defined in the 17 definition of this Chapter. The manner of equating the Argument, is taught in the 15 Precept.

19. The equall simple mouing of the Sunne is an arch of the Ecliptick, beginning at the first starre of the Rams horne, and ending at the line of the Imaginarie motion (which line we call hereafter the line of the meane mouing of the Sunne) as in the foresaid second figure of this Chapter, the arch \* N is the equall simple mouing of the  
the

the Sunne: The quantitie of which simple moouing is  $\overset{i}{5} \overset{ii}{9} \overset{iii}{8} \overset{iiii}{11} \overset{v}{22}$ . euery day, and according to this motion the Sunne maketh one entire reuolution in 365 dayes, 6 houres,  $\overset{i}{49} \overset{ii}{16}$ .

20. The equall compound moouing of the Sunne is an arch of the Eclipticke, beginning at the meane vernall Equinox, and ending at the line of the meane moouing of the Sunne. Whereby it appeareth, that if the meane Precession of the Equinox be added vnto the equall simple motion of the Sunne, the summe of that addition will be the compound motion of the Sun. And the daily compound motion is  $\overset{i}{19} \overset{ii}{8} \overset{iii}{19} \overset{iiii}{13}$ . whereby the Sunne according to the equall compound motion maketh his reuolution in 365 dayes, 5 houres,  $\overset{i}{49} \overset{ii}{16}$ . The manner of finding of these two equall motions of the Sun, that is to say, the simple and compound moouing, is taught in the 8 Precept, by helpe of the 13 and 14 Cannons.

21. The true motion of the Sunne is an arch of the Eclipticke, beginning at the first star of the Rams horne, and ending at the true place of the Sunne: and then is the said true motion called the true moouing of the Sun vnder the 8 sphere. But sometimes the said arch of true motion is supposed to begin at the true Vernall Equinox, and then it is called the true motion of the Sunne vnder the first mouable.

22. The proportionall minutes are the 60 parts whereby the equacions of the Argument doe encrease or decrease, according as the excentricitie of the Sun encreaseth or decreaseth. The finding of which proportionall minutes is taught in the fifteenth Precept, and are set downe in the seuenteenth Cannon in the Collum, whose



title is *Scrupula Proportionalia*.

23. The equacion of the Argument or yearely Prosthapheresis is an arch of the Eclipticke, which is comprehended betwixt the line of the meane moouing and the line of the true mouing of the Sun. And this equacion of the Argument is nothing, when the Sunne is either in the Auge or in the opposit Auge of the Excentrique, and is alwaies greatest in the meane longitudes of the Sunne: which meane longitudes are pointed out in the circumference of the Excentrique, by a right line drawne perpendicularly vpon the line of the true Auge through the centre of the world. As in the foresaid second figure of this Chapter, the line A D is the line of the true Auge of the Excentrique, which another line crosseth with right angles in the point A, which perpendicular line is the line T V, and beeing produced vnto the Excentrique, sheweth the points T and V to be the points of meane longitudes. And the greatest equacion of the Argument that can be, which is when the centre of the Excentrique is in the Auge of the little circle, is two degrees,  $\frac{i}{24}$   $\frac{ii}{24}$ . and that is when the Sun is distant from the true Auge or from the Auge of the Excentrique 93 degrees. But when the centre of the Excentrique is in the opposit Auge of the said little circle, then is the greatest equacion of the Argument no more but 1 degree,  $\frac{i}{24}$   $\frac{ii}{24}$ . and that is when the distance of the Sunne from the true Auge, is 92 degrees. And this equacion is called in the tables, The equacion of the orbe: the finding whereof is taught in the 15 Precept, by helpe of the 17 Cannon, in the Collum whose title is *Orbis*.

24. The true argument of the Sunne, is the distance of the Sunne from the true Auge of his Excentrique.

25. The

25. The excesse or diuersitie of the diameter, is an arch of the Eclipticke, whereby the equacion of the argument (the centre of the Excentrique being in the Auge of the little circle) exceedeth the equacion of the argument, when the centre of the Excentrique is in the opposit Auge of the little circle. The true argument of the Sunne being of one selfe quantitie in each position of the centre of the Excentrique in the circumference of the little circle. For the equacions of the argument doe decrease continually, so long as the centre of the Excentrique is descending from the Auge of the little circle, vntill it come to the opposit Auge of the said little circle, and from thence do begin againe to encrease, vntill the centre of the Excentrique returneth again vnto the Auge of the little circle. The finding of which Excesse is taught in the 15 Precept, and is set downe in the 17 Cannon in that Colume, whose title is *Excessus*.

26. The coequated and true equacion, which is otherwise called the absolute equacion of the orbe, is an arch compounded of the true equacion of the argument, and of the excesse, proportionable vnto the proportionall minutes.

#### CHAP. IX.

##### *Of the third Heauen, or Heauen of Venus.*

**T**He next Heauen vnder that of the Sunne, is the Heauen of Venus, which hath his proper mouing from West to East.

This Heauen hath foure orbes, as the Heauen of the three higher Planets haue, that is to say, two, which are called the deferents of the two Auges, then the Orbe  
Excen-



Excentrique, or the deferent of the Epicicle, and the Epicicle it selfe, in the circumference whereof the Planet is alwayes carried. And because I haue defined the said orbes in the fift Chapter, I thinke them needlesse to be here againe repeated: and therefore I referre you to that Chapter: For the Orbes of Venus doe not differ from the Orbes of Saturne in shape and position, but onely in the quantitie of their motions.

The deferents of the Auge and opposit Auge in the Heauen of Venus do continue without any motion, and the place of her Auge, which is in the Eclipticke of the eight Heauen, is alwaies 48 degrees,  $\frac{1}{2}$ , reckoning from the first starre of the Rams horne: and the opposit Auge is alwaies 3 Sex. 48 degrees,  $\frac{1}{2}$ , from the first starre of the Rams horne, accounting the said distance according to the succession of the signes. The Excentrique of Venus mooueth according to the succession of the signes vpon his proper centre, which is differing from the centre of the world, and the poles and axletree of this Orbe are moouable, sometimes approaching neare vnto the poles of the Eclipticke, and at other times are further off. Howbeit this Excentrique maketh one entire reuolution, beginning at the first starre of the Rams horn in 365 dayes, 6 houres,  $\frac{1}{9}$ ,  $\frac{11}{9}$ , so as the moouing of this orbe is equall vnto the simple equall mouing of the Sunne, before defined in the 19 definition of the 8 Chapter. And therefore the line of the meane moouing of the centre of Venus her Epicicle, is alwaies in the same place of the Zodiacke, in which the line of the meane mouing of the Sunne is: so as in seeking for the meane mouing of Venus her longitude, you are to find the simple equall mouing of the Sunne in such order as the eight Precept teacheth:



cheth: from which if you subtract 48 degrees,  $\frac{i}{21}$ . the remainder will shew the meane Anomalia of the Excentrique, or meane centre, before defined in the 13 definition of the 7 Chapter. Which if you subtract out of the true motion of the longitude of the Epicicle (which is defined in the 17 definition of the 7 Chapter) the remainder will be the true centre or the equated Anomalia of the Excentrique, which is defined in the 16 definition of the 7 Chapter.

The Epicicle of Venus hath also his proper motion in the Excentrique, whereby it swarueh from the plane of the Excentrique.

The semidiameter of the Epicicle is 43 degrees,  $\frac{i}{10}$ . such like degrees, as the semidiameter of the Excentrique containeth 60 degrees. And because that the line of the meane moouing of her centre is all one with the line of the meane moouing of the Sunne, it may easily appeare, that the starre or Planet will be twice conjoined with the Sunne in one reuolution of her Epicicle, that is to say, once in the Auge, and once in the opposit Auge of the Epicicle. But if she be neither in the Auge nor in the opposit Auge of the Epicicle, then in her ascending from the opposit Auge of her Epicicle vnto the Auge thereof she goeth before the Sunne, and is our morning star, called of the Latines *Lucifer*. But in descending from the Auge of her Epicicle vnto the opposit Auge thereof, she goeth after the Sunne, and is our euening star, called of the Latines *Hesperus*.

The daily moouing of the Anomalia of Commutation (which was defined in the 23 definition of the 7 chapter) is  $\frac{i}{36}$ .  $\frac{ii}{50}$ .  $\frac{iii}{28}$ . and the yearely motion thereof is 3 Sex. 45 degrees,  $\frac{i}{45}$ .  $\frac{ii}{21}$ .  $\frac{iii}{21}$ . and maketh one entire reuolution



in one yeare 218 dayes, 21 houres, 15 minutes.

The greatest equacion of her Epicycle is 45 degrees, <sup>i.</sup><sub>10.</sub> <sup>ii.</sup><sub>10.</sub> if the centre of the Epicycle be in the Auge of her Excentrique, and that the Planet bee distant from the Auge of the Epicycle any way 2 Sex. 15 degrees, <sup>i.</sup><sub>10.</sub> but if the centre of the Epicycle be in the opposit Auge of the Excentrique, and that the Planet be distant 2 Sex. 17 degrees from the Auge of the Epicycle, then is the greatest equacion of the argument of Venus 46 degrees, <sup>i.</sup><sub>10.</sub> <sup>ii.</sup><sub>29.</sub> What other points, lines, and arches are needfull to be known for the calculating of her motion at any time, are set downe before in the 7 Chapter, vnto which I referre you, onely the finding of the equacions belonging vnto this Planet, must be sought for in the 22 Cannon, in such order as is taught in the 34 Precept. And thus I end with Venus.

#### C H A P. X.

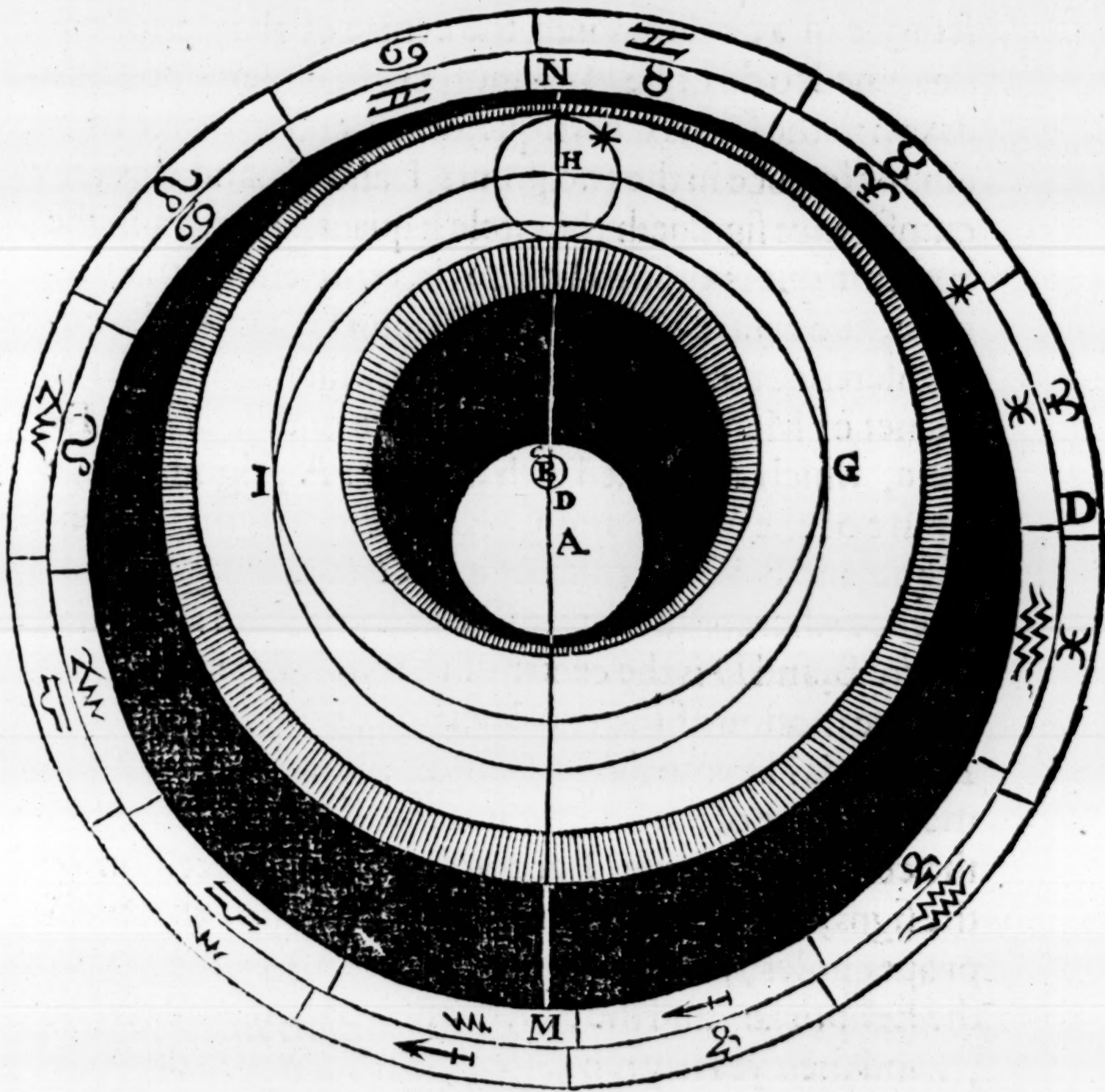
##### *Of the second Heauen, or Heauen of Mercurie.*

**N**Ext vnder the Heauen of Venus is the Heauen of Mercurie, which consisteth of six orbes, that is to say, 2 deferents of the Auge of the circle Equant, two deferents of the Auge of the Anomalialia of the Excentrique, the fift orbe is the Excentrique, and the sixt is the Epicycle.

The five first orbes are in all respects like vnto the five orbes of the Sun, whereof wee spake in the 8 Chapter. And the sixt orbe, which is the Epicycle, is like vnto the Epicycle in the other Planets whereof we spake in the fift Chapter. Notwithstanding I think it not amisse for your better vnderstanding to set downe the said orbes in this figure here next following.

¶ *The*

¶ *The first figure belonging to the Theorique  
of Mercurie.*



**I**N this figure the two outermost circles, in which are  
set the characters of the twelve signes, doe signifie the  
two Eclipticks, one of the first mouable, the other the  
Eclipticke of the eight Heauen. The two broad & black  
circles doe signifie the two deferents of the Auge of the  
circle

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circle Equant, and the two shaddowed circles do signifie the deferents of the Auge of the Excentrique, and betwixt them is a broad white circle, which representeth the Excentrique: in the middest whereof is the circumference of a circle, which the centre of the Epicycle is imagined to describe. And another circumference is also drawn in the said Excentrique, which cutteth the former circumference in the two points I and G, and this circumference signifieth the circle Equant. Againe, in the Excentrique is another litle circle, representing the Epicycle, the centre whereof is the point H, and in the circumference thereof is a little starre, which signifieth the Planet of Mercurie. The point in the middle of this Figure, which is marked with the letter A, signifieth the centre of the world, and C is the centre of the Excentrique, and B is the centre of a litle circle, in the circumference whereof the centre C alwaies moueth about the centre B, and D is the centre of the circle Equant.

The motion of the two deferents of the Auge of the Equant is like vnto the motion of the deferents of the meane Auge of the Sun, for it is equall and regular vpon the centre of the world according to the succession of the signs, that is to say, from West to East vpon their own proper poles, which are equally distant from the poles of the Eclipticke: and the daily motion of these orbes is  $\frac{iii}{9}$ . and their yearely motion is  $\frac{ii}{57} \cdot \frac{iii}{50} \cdot \frac{iiii}{38}$ . and so do make one entire reuolution in 22700 Egyptian yeares.

The excentricitie, that is to say, the distance of the centre of the circle Equant from the centre of the world, is 3 degrees, such degrees as the semidiameter of the said circle Equant containeth 60 degrees. The line A B N signifieth the line of the Auge of the circle Equant: and  
this



this line is drawne through the centre of the world, and also through the centre of the little circle, marked with B, euen as the line of the meane Auge of the Sunne is wont to be drawne, as was said in the third definition of the eight Chapter. And the place of the Auge of the said circle Equant is marked with the letter N, like as the point M is the place of the opposit Auge of the said circle Equant. And the arch of the eight Eclipticke, marked with the first starre of the Rams horne, and with the letters M N, is the motion of the Auge of the Equant vnder the eight sphere. But the arch D M N is the motion of the said Auge vnder the first mouable or from the true Equinoctiall point, marked in the said Eclipticke of the first mouable with the letter D.

The deferents of the Excentrique doe moue regularly about the centre of the little circle, contrarie to the succession of the signes, as the orbes of the Anomalia of the Auge of the Sunne doe mooue namely vpon their proper poles and axletree, and do make their reuolution in 365 dayes, 6 houres,  $\frac{1}{3}$ .  $\frac{11}{8}$ . and their daily motion is  $\frac{1}{59}$ .  $\frac{11}{8}$ .  $\frac{111}{1}$ .  $\frac{1111}{52}$ . And the centre of the little circle is distant from the centre of the world 6 degrees, and from the centre of the Equant 3 degrees, such degrees I mean as the semidiameter of the Equant containeth 60 degrees. By meanes of which motion, the excentricitie of the Planet changeth euery day, and is greatest when the centre of the Excentrique is in the Auge of the little circle, and the said excentricitie is least when the centre of the said Excentrique is in the opposit Auge of the said little circle, and the said excentricitie is meane when the centre of the centre of the Excentrique is in the middle point betwixt the Auge and opposit Auge of the said

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little



little circle. All which things were shewed in the 7, 8, and 9 definitions of the 8 Chapter.

The Excentrique hath his proper motion vpon his owne poles, which are also moouable, and the motion thereof is according to the succession of the signs, which motion although it be irregular and vnequall in respect of the centre of the world, yet is the same regular and equall in respect of the centre of the circle Equant: and the daily motion is  $\frac{i}{9} \cdot \frac{ii}{8} \cdot \frac{iii}{1} \cdot \frac{iiii}{2}$  and maketh one entire reuolution in 365 dayes, 6 houres,  $\frac{i}{3} \cdot \frac{ii}{8}$ . And this motion is found by subtracting the daily motion of the deferents of the Auge of the Equant (which is  $\frac{iii}{9} \cdot \frac{iiii}{1}$ ) out of the daily motion of the longitude of Mercurie, which is  $\frac{i}{59} \cdot \frac{ii}{8} \cdot \frac{iii}{11} \cdot \frac{iiii}{22}$  for so the remainer wil be  $\frac{i}{9} \cdot \frac{ii}{8} \cdot \frac{iii}{1} \cdot \frac{iiii}{2}$  which summe is the daily motion of the Excentrique, counting from the line of the Auge of the Equant. And you haue to note, that the motion of the longitude of Mercurie is equall vnto the simple equall mouing of the Sunne, so as when you are to find out the equall longitude of Mercurie, you haue to seek in the Prutenical tables the equal simple mouing of the Sunne for the time giuen: and as for the moouing of the Anomalia of the Excentrique, you are taught how to find the same at any time by the 8 Precept, by helpe of the 13 and 14 Cannons, in the Collum, whose title is *Apogei Mercurij*.

As for the true Auge of the Excentrique, the same is found as was shewed, in the 15 definition of the 8 Chap.

The Epicicle of Mercurie hath his proper motion vpon his mouable axletree, and the daily motion thereof is 3 degrees,  $\frac{i}{6} \cdot \frac{ii}{24} \cdot \frac{iii}{14} \cdot \frac{iiii}{5} \cdot \frac{v}{36}$  and maketh one entire reuolution in 115 dayes, 21 houres,  $\frac{i}{3} \cdot \frac{ii}{26} \cdot \frac{iii}{14}$  and the semi-diameter of the Epicicle is 22 degrees,  $\frac{i}{30}$  such degrees

as the semidiameter of the Excentrique containeth 60, like as was said before of Venus: For since the motion of his longitude is alwaies equall vnto the equall simple mouing of the Sunne, it cannot be but that this Planet must be alwaies neare vnto the Sunne; sometimes going before the same, and then it may be seene in the morning before the Sunne riseth; and sometimes it followeth the Sun, and then it may be seene in the euening.

Lastly, the greatest equacion of the Argument of Mercurie, when the centre of his Epicicle is in the Auge of his Excentrique (the Planet being then distant from the Auge of the Epicicle 109 degrees) is 19 degrees,  $\frac{1}{3} \cdot \frac{11}{6}$ . But if he be distant 114 degrees from the Auge of his Epicicle, and that the centre of the Epicicle be in the opposit Auge of the Excentrique, then is the greatest equacion of his argument 23 degrees,  $\frac{1}{5} \cdot \frac{11}{37}$ .

Now, as for the points, lines, and arches belonging to the calculating of the Motions of Mercurie, because they doe not differ from those which we haue shewed in the 5 Chapter, I therefore referre you to that Chapter: and as for the particular equacions, you shal find them set down in the 23 Cannon of the Prutenicall Tables.

#### C H A P. X I.

##### *Of the first Heauen, or Heauen of the Moone.*

**T**He last or lowest Heauen is the Heauen of the Moone, and it consisteth of foure orbes, whereof the first is called the orbe or circle of the Nodes, or the deferent of the head and taile of the Dragon.

The next orbe is called the deferent of the Epicicles.  
The third orbe is called the first Epicicle.

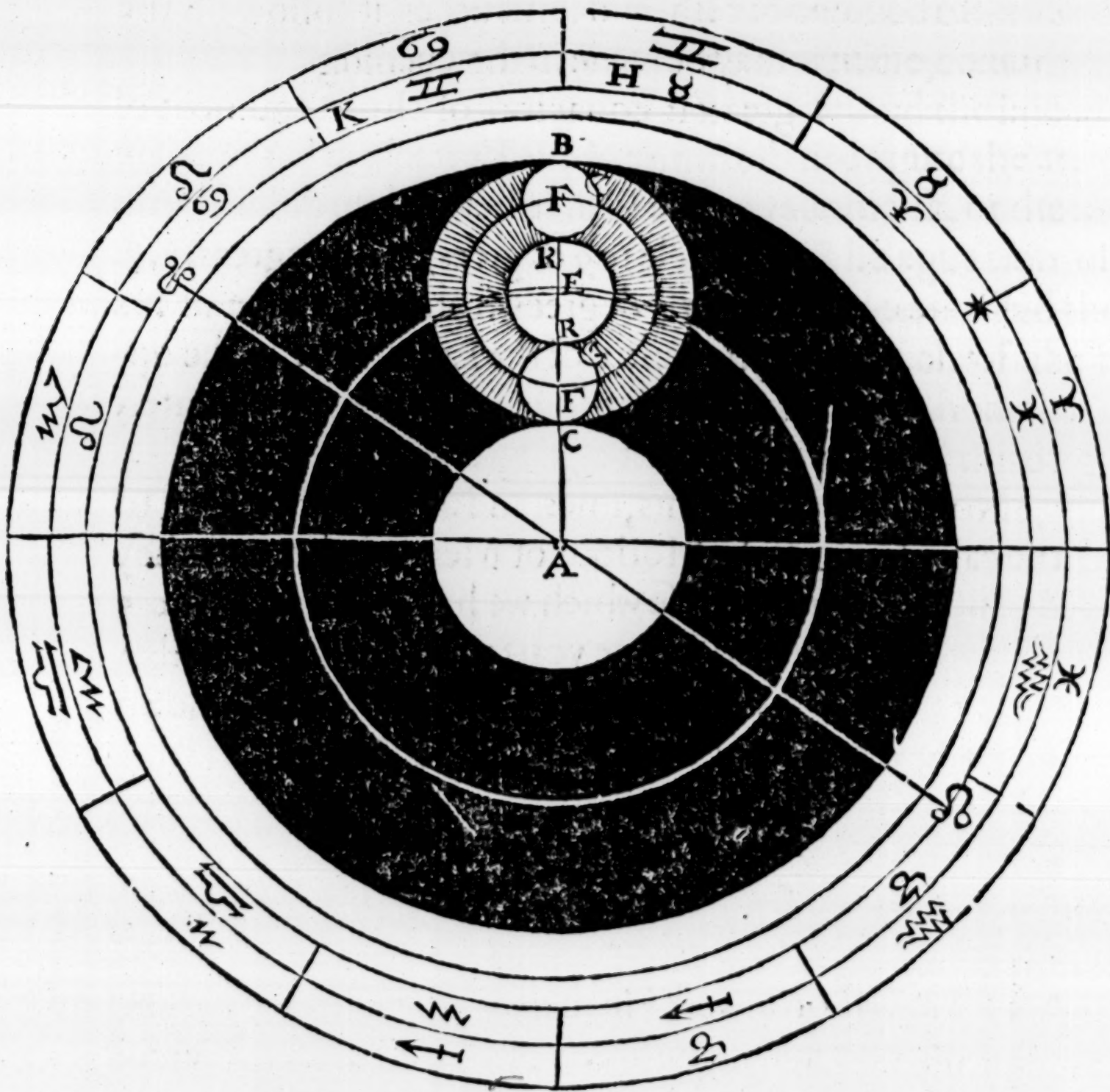
And



And the fourth is the second Epicicle.

All which orbes are set down in this figure following.

¶ The first figure belonging to the Theorique of the Moone.



You shall find the two Epicles of the Moone more plainly set downe in the third figure here following.

In

**I**N the former figure, the two outermost circles do signify the two Eclipticks, as in the Heauen of Mercurie.

Next vnto them is another white circle, in which are set the characters of the head and taile of the Dragon, signifying the deferent of the Nodes, and in the middle thereof is the circumference of a circle, in which the two Nodes doe continually moue. Next vnto that is a great broad and blacke orbe, signifying the deferent of the Epicicles: in which orbe is a shadowed circle, which representeth the first Epicicle, whose centre is marked with the letter E: and vpon the perpendicular line C B are placed two other little circles, one aboue, and another beneath the centre E, both whose centres are marked with the letter F, and these two little circles beeing white within, doe signifie the second Epicicles. And in the circumference of either of them is set the character of the Moone. The point A signifieth the centre of the world, the point B signifieth the Auge of the first Epicicle, and the point C is the opposit Auge of the said first Epicicle.

1. The deferent of the Nodes is an orbe in the Theorique of the Moone, in which the Nodes doe continually moue, marked in the former figure with the head and taile of the Dragon, describing the middle circle of the said orbe. This orbe is concentricall, that is, hath one selfe centre with the Zodiacke: and the motion of this orbe is regular and equall in respect of the centre of the earth, vpon the axletree and poles of the Zodiacke, contrarie to the succession of the signes, and the daily motion thereof is  $\frac{i}{3}$ .  $\frac{ii}{10}$ .  $\frac{iii}{47}$ . and in one yeare  
M m mooueth.

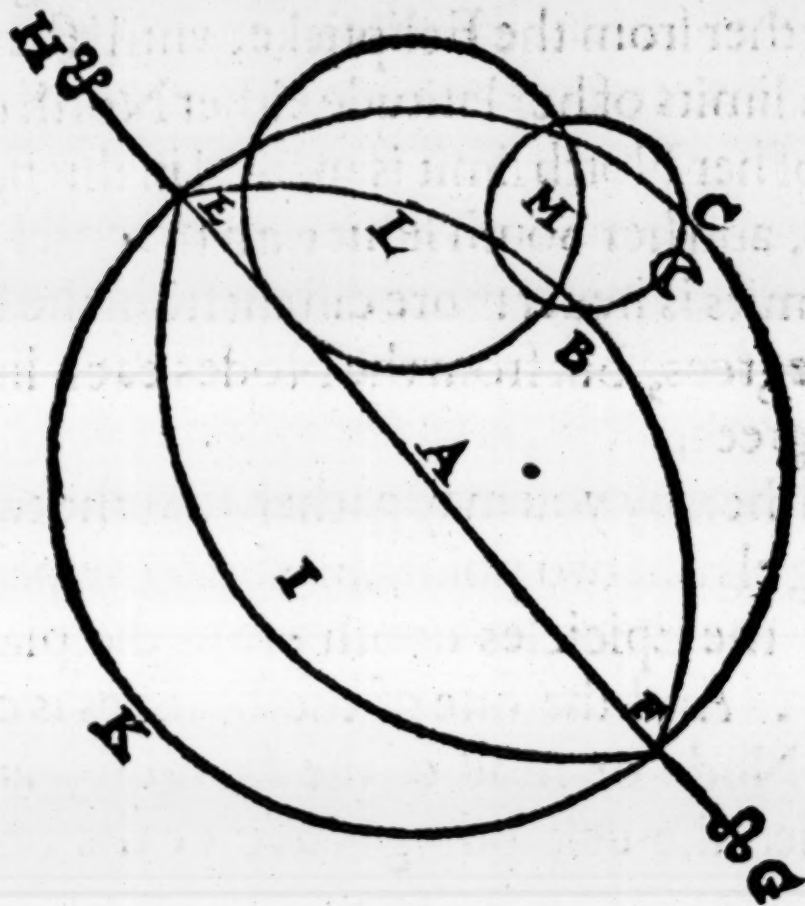


mooueth 19 degrees,  $\frac{i}{10}$   $\frac{ii}{33}$   $\frac{iii}{44}$  and so maketh one entire reuolution in 18 Ægyptian yeares, 223 dayes, 6 houres,  $\frac{i}{11}$  and by the violence or strength of his motion, he carrieth the other orbes round about with him.

2. The deferent of the Epicles is the foresaid blacke Orbe in the Theorique of the Moone, in which the Epicles of the Moone are carried continually about. And this blacke orbe hath his owne proper motion, which is according to the succession of the signes, and is regular in respect of the centre of the world, marked with the letter A, and mooueth vpon his owne axletree, which cutteth the axletree of the Eclipticke in the point A, the centre of the world, and the poles thereof are alwayes no more but five degrees from the Eclipticke: whereby it happeneth, that the plane of this Orbe cutteth the plane of the Eclipticke in two points, which are called the Nodes, or the head and taile of the Dragon. For the vnderstanding whereof I haue set downe this other figure next following.

¶ The

¶ The second figure belonging to the Theorique  
of the Moone.



**I**N which figure the circle F C E K signifieth the plane  
of the Eclipticke, and the centre thereof is marked  
with the point A : and the circle F B E I signifieth  
the plane of the deferent of the Epicicle, in the circum-  
ference whereof is the centre of the first Epicicle, mar-  
ked with the letter L; and in the circumference thereof  
is the centre of the second Epicicle, marked with the let-  
ter M, and in the circumference thereof is the character  
of the Moone : and the centre of the deferent of the Epi-  
cicle, is the same which the Eclipticke hath, that is to say,  
the centre A; and this circle crosseth the Eclipticke in  
two opposit points, that is to say, in the point F and E,  
called the Nodes, the one of which is called the head of  
the Dragon, marked with this character  $\Omega$ , and the other  
is called the taile of the Dragon, marked with this cara-

M m ij

cter



eter  $\psi$ . Vnto either of which two Nodes when the Moon commeth, then she is in the Eclipticke, and in her moouing from either of the said two Nodes shee goeth further and further from the Eclipticke, vntill she come to one of the 2 limits of her latitude either North or South. 3. Whereof her North limit is marked in this figure with the letter B, and her South limit with the letter I, either of which limits is neuer more distant from the Ecliptick than five degrees, but from the Nodes each limit is distant 90 degrees.

4. And hereby you may gather, that the two Nodes are nothing els but two points, in which the plane of the deferent of the Epicles dooth crosse the plane of the Eclipticke. And the one of these Nodes is called the ascending Node or head of the Dragon, and the other is called the descending Node or the taile of the Dragon.

5. The head of the Dragon is that Node, vnto which when the Moon commeth, she beginneth to go Northward from the Eclipticke: and that Node is marked with this character  $\Omega$ .

6. The taile of the Dragon is that Node, vnto which when the Moone commeth, she beginneth to go Southward from the Ecliptick, which Node is marked with this character  $\psi$ .

7. The line of the mean or true mouing of the Nodes is a line drawne from the centre of the world vnto any of the said Nodes: as in the former figure the line A F signifieth the line of the mouing of the head of the Dragon, and the line A E signifieth the line of the mouing of the taile of the Dragon.

8. The meane mouing of the Nodes is an arch of the Eclip-

Eclipticke, beginning at the first star of the Rams horne or at the first true Vernall Equinox, and endeth at the line of the mouing of the Node, so as the said arch bee reckoned contrarie to the succession of the signes.

9. The true moouing of the Nodes is an arch of the Eclipticke, beginning at the first starre of the Rams horn, if the same bee reckoned in the Eclipticke of the eight Heauen, or at the true Vernall Equinox, if the same bee reckoned in the Eclipticke of the first mouable, and ending at the line of the mouing of the Node, so as the said arch be numbered according to the succession of the signes.

10. The line of the meane mouing of the Moone is a line drawne from the centre of the world through the centre of the first Epicicle, and so forth vnto the Eclipticke. As for example, in the first figure the right line A E B is the line of the meane mouing of the Moone.

11. The place of the centre of the first Epicicle in the Eclipticke, is that point in which the line of the meane mouing of the Moone falleth in the Eclipticke. As in the said first figure the point B in the Eclipticke is the place of the centre of the first Epicicle.

12. The meane simple moouing of the Moones longitude, is an arch of the Eclipticke, beginning at the first starre of the Rams horne, and ending at the place of the centre of the first Epicicle. As in the said first figure the arch \* H K is called the mean, equall, or simple mouing of the Moones longitude: and the daily mouing of this simple longitude is 13 degrees,  $\overset{i}{10} \cdot \overset{ii}{34} \cdot \overset{iii}{53}$ . and according vnto this motion the Moone maketh her reuolution in 27 dayes, 7 houres,  $\overset{i}{43} \cdot \overset{ii}{7}$ . for in this time shee returneth vnto the first starre of the Rams horne, and this is called



the Periodicall moneth. As in the first figure the arch  $\star H K$  is the equall simple mouing of the longitude of the Moone.

13. But if the said motion dooth begin at the meane place of the Sunne, that is, at the line of the meane mouing of the Sunne, then is it called the equall or meane longitude of the Moone from the Sunne, and then the daily motion is 12 degrees,  $\frac{i}{11} \cdot \frac{ii}{26} \cdot \frac{iii}{41}$ . and according vnto this, the Moone maketh her reuolution in 29 dayes, 12 houres,  $\frac{i}{44} \cdot \frac{ii}{3}$ . and the time of this reuolution is called the Synodicall moneth. So as if you subtract the equall simple moouing of the Sunne out of the equall simple moouing of the Moones longitude, the remainder will shew the meane longitude of the Moone from the Sunne. As in the said first figure suppose the arch  $\star H$  to be the equall simple mouing of the Sunne, and the arch  $\star H K$  to be the equall simple moouing of the Moones longitude. Now if you subtract  $\star H$  out of  $\star H K$ , the remainder will be  $H K$ , and that is the meane longitude of the Moone from the Sunne. And the finding of this at any time giuen, is taught in the 8 Precept, by helpe of the 13 and 14 Cannons, in the Collume whose title is *Longitudo media à Sole*.

14. And againe, sometimes the meane moouing of the centre of the first Epicicle or of the Moone, is accounted to begin at the North limit, and then is it called by *Ptolomey* and *Copernicus* the mean motion of the latitude of the Moone; because that after the same be corrected, it sheweth the true latitude of the Moon: & the finding of this motion at any time is to be found in such order as is shewed in the 8 Precept, by help of the 13 and 14 Cannons in the Colume, whose title is *Latitudinis Lune*.

15. But



15. But *Alphonfus* and his followers make the beginning of the said motion to be at the head of the Dragon, and is called by them the Argument of the latitude of the Moone, and the daily motion of the Moons latitude is 13 degrees,  $\frac{i}{3}$ .  $\frac{ii}{45}$ .  $\frac{iii}{9}$ . and according vnto this motion she maketh her reuolution in 27 dayes, 5 houres,  $\frac{i}{3}$ .  $\frac{ii}{6}$ . And the Argument of the Moones latitude is to be found at any time giuen, by adding of 90 degrees vnto the mean motion of her latitude: the manner of the finding whereof was shewed in the 14 definition of this Chapter.

16. And you haue to note, that according to the motion of the deferent of the Epicicle, the centre of the Epicicle is imagined to describe a circle in the middle of the said deferent: which circle is called the circle of the mouing of the centre; and this circle is signified in the first figure by the white circle in the middle of the blacke deferent of the Epicicle, described by the centre of the first Epicicle.

17. The first Epicicle is an orbe in the Theorique of the Moone, which continually carieth about the second Epicicle of the Moone. This orbe hath his owne proper motion about his owne poles and axletree, which axletree is perpendicular vnto the plane of the deferent of the Epicicle, and is paralell vnto the said axletree of the said deferent: wherby it commeth to passe, that the plane of this first Epicicle is alwaies in the plane of his deferent. And the motion of this Epicicle is contrary to the succession of the signes, and the daily motion thereof is 13 degrees,  $\frac{i}{3}$ .  $\frac{ii}{45}$ .  $\frac{iii}{9}$ . and maketh one entire reuolution in 27 dayes and 13 houres almost: and the semidiameter of this Epicicle is 6 degrees,  $\frac{i}{3}$ . whereof the semidiameter of



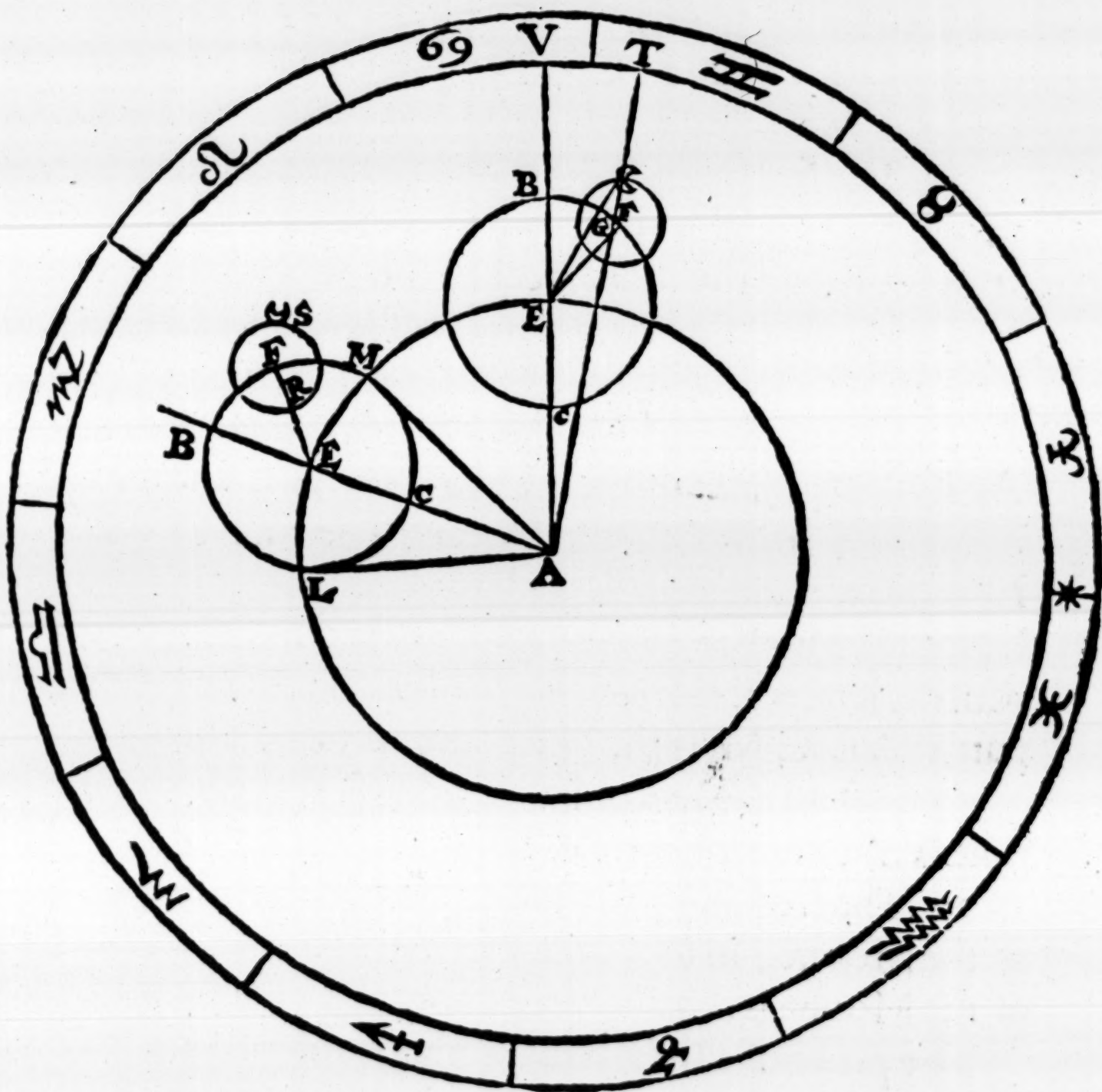
of the mouing of his centre containeth 60.

18. The Auge of the first Epicicle is a point in the superficies thereof, which is furthest distant from the centre of the earth. And the opposit Auge is that point which is nearest vnto the centre of the earth. And the Auge and opposit Auge is determined by a right line drawne from the centre of the earth vnto the circumference of the said first Epicicle, through the centre of the same. As in the first figure the point B is the Auge of the first Epicicle, and the point C the opposit Auge thereof.

19. The meane Anomalia of the Epicicle, which is otherwise called the meane Argument, is an arch of the first Epicicle, containing the distance betwixt the centre of the second Epicicle, and the Auge of the first Epicicle. And this is determined by a right line drawne from the centre of the first Epicicle vnto the centre of the second Epicicle, as this figure next following sheweth.

**The**

¶ The third figure belonging to the Theorique of the Moone.



**I**N which figure, the outermost circle representeth the  
Eclipticke, and the lesser circle within that is a circle  
which the centre of the first Epicycle is imagined to de-  
scribe. The semidiameter whereof is the line A E, and  
the point E signifieth the centre of the first Epicycle,  
whose semidiameter is the line E B, and the point B is  
the

N n



the Auge, and the point C the opposit Auge thereof: the point F signifieth the centre of the second Epicicle, and the arch B F is the meane Anomalia of the Moon: and this is called *Anomalia motus* in the Prutenicall tables, the finding whereof is taught in the 8 Precept by helpe of the 13 and 14 Cannons, in the Colume, whole title is *Anomalia Lune*.

20. The first Epicicle is imagined to be deuided into two parts, whereof the one part is called the higher or vpper part, and the other is called the lower part of the Epicicle. And these two parts are shewed by two right lines, drawne from the centre of the world, marked with A, so as they touch the said first Epicicle on both sides. As in this present figure the two lines, A L and A M are drawne from the centre A, and doe touch the first Epicicle in the points L and M: and that part of the Epicicle, which is aboue the points L and M, marked with the letters L B F M, is the higher part, but the other part, *viz.* L C M, is the lower part of the Epicicle.

21. And the two points L and M are the Touch-points of the first Epicicle.

22. The second Epicicle is an Orbe in the Theorique of the Moone, in the circumference whereof the bodie of the Moone is alwaies carried about.

The plane of this Epicicle is alwaies in the plane of the first, and the axletree thereof is perpendicular vnto the plane of the first Epicicle, and therefore the axletrees of the two Epicicles and of the deferent of the first Epicicle, are paralels one to another.

And the mouing of this second Epicicle is contrarie vnto the moouing of the first Epicicle: and the motion hereof beginneth at the Auge of the second Epicicle.

23. The

23. The Auge of the second Epicicle is that point in the circumference of the said second Epicicle, which is nearest vnto the centre of the first Epicicle: and the opposit Auge thereof is furthest from the centre of the said Epicicle: for these Auges haue respect to the centre of the first Epicicle, and not to the centre of the earth.

24. The Anomalia of the Excentrique, which some call the centre of the Moone, is an arch of the second Epicicle, beginning at the Auge of the said second Epicicle, and ending at the body of the Moone. As in the third figure of this Chapter the point R signifieth the Auge of the second Epicicle, and the place of the Moon is signified by her proper character in the circumference thereof, and the arch of the said little circle, contained betwixt R and the character of the Moone, is called the Anomalia of the Excentrique, or centre of the Moone. And this Anomalia is called in the Prutenicall Tables *Longitudo Duplicata*, or the double longitude of the Moone from the Sunne: and the simple longitude was defined before in the 13 definition of this Chapter.

And it is called the doubled longitude, because that the motion of the Moone in the second Epicicle is double vnto the motion of the centre of the first Epicicle, from the line of the meane moouing of the Sunne. For according vnto this motion the Moone maketh her revolution in 14 dayes, 18 houres,  $\frac{1}{22} \cdot \frac{11}{1}$ . and her daily motion is 24 degrees,  $\frac{1}{22} \cdot \frac{11}{3} \cdot \frac{11}{3}$ . and is found in the Prutenicall tables, by doubling the meane longitude of the Moone from the Sunne.

25. The line of the true Anomalia of the Moone is a right line drawne from the centre of the first Epicicle vnto the body of the Moone. As in the third figure of this



Chapter the right line E G, and the character of the Moone is called the line of the true Anomalia, because it is drawne from the centre of the first Epicicle, which is marked with the letter E, vnto the body of the Moone, marked with the character of the Moone.

26. The true Anomalia of the Moone, which the *Alphonsines* doe call the true Argument, is an arch of the first Epicicle, contained betwixt the Auge of the said first Epicicle, and the line of the true Anomalia. As in the said third figure the arch B G is called the true or equated Anomalia, or the true Argument of the Moone.

27. The equacion of the centre, which in the Prutenicall tables is called the equacion of the second Epicicle, is an arch of the first Epicicle, whereby the true and meane Anomalias do differ the one from the other. As in the said third figure the arch B G is the true Argument of Moone, and the arch B F is the mean Anomalia or Argument of the Moone, or of the Epicicle, defined in the 19 definition of this Chapter: the difference betwixt these two arches, is the little arch G F, and this difference, is called the Prosthapheresis of the centre. The finding whereof by the Prutenicall tables, is taught in the 24 Precept, by helpe of the 18 Cannon, in that Collum whose title is *Secundi Epicycli*. And this equacion is to be added or subtracted from the mean Anomalia, as is shewed in the said 24 Precept, to the end that the true Argument or Anomalia may bee had. And the greatest equacion that can be, is 12 degrees,  $\frac{1}{2}$ ,  $\frac{1}{6}$ ,  $\frac{1}{7}$ , which then happeneth, when the Moone is in either of the Touch-points of the second Epicicle: which Touch-points are determined by two right lines drawne from the centre of the first Epicicle; and touching the circumference



cumference of the second Epicicle, on each side thereof.

28. The line of the true motion of the Moon is a right line drawn from the centre of the world, through the body of the Moon vnto the Ecliptick, & the point in the Eclipticke, where that line endeth, is the true place of the Moone: as in the third figure the line A G T signifieth the line of her true mouing, and the point T is the true place of the Moone.

29. The true or apparent motion of the Moone is an arch of the Eclipticke, beginning at some knowne place of the Eclipticke, and ending at the true place of the Moone: which arch dooth begin either at the first starre of the Rams horne, or at the Vernall Equinox, either meane or true, or els at the line of the meane place of the Sunne. As in the said third figure the arch \* T is the apparent or true moouing of the Moone from the first starre of the Rams horne.

30. The equacion of the first Epicicle is an arch of the Eclipticke, contained betwixt the line of the meane mouing of the Moone, and the line of her true mouing. As for example, in the third figure of this Chapter the line A V is the line of the meane mouing of the Moon, and the line A T is the line of her true mouing, and the arch of the Eclipticke, contained betwixt these two lines, that is to say, the arch T V, is called the equacion of the first Epicicle, or the equacion of the Argument. And the finding of this equacion at any time giuen, is taught in the 24 Precept, by helpe of the 18 Cannon, in the Collum, whose title is *Primi Epicycli*. But because this equacion doth varie, and is sometimes greater and sometimes lesse, therefore the absolute and perfect equacion is to be



278     *A breefe Extract of Maginus, &c.*

found by the proportionall minutes, and the excesse,  
which were defined before in the 29 definition of the fifth  
Chapter, and therefore I need not here again to define  
the same, but onely to tell you, that the proportionall  
minutes are to be found in the 18 Cannon, in the Col-  
lum, whose title is *Scrupula Proportionalia*: and the  
excesse is to be found in the said 18 Can-  
non, in the Colume, whose title is  
*Excessus*.

*Here endeth my Extract of Maginus his Theoriques: And  
if this my labour shall content you, then looke shortly  
for the vse of the Prutenicall Tables.*



THE  
MAKING, DESCRIP-  
TION, AND VSE, OF  
TWO MOST INGENIOVS AND  
necessarie Instruments for Sea-men, to find out  
thereby the latitude of any place vpon the Sea or  
Land, in the darkeſt night that is, without the  
helpe of Sunne, Moone, or Starre.

First inuented by my good friend, Ma-  
ſter Doctor *Gilbert*, a moſt excellent Philoſopher,  
and one of the ordinarie Phyſicians to her Maieſtie:  
and now here plainly ſet downe in our mother  
tongue by Maſter *Blundeuile*.



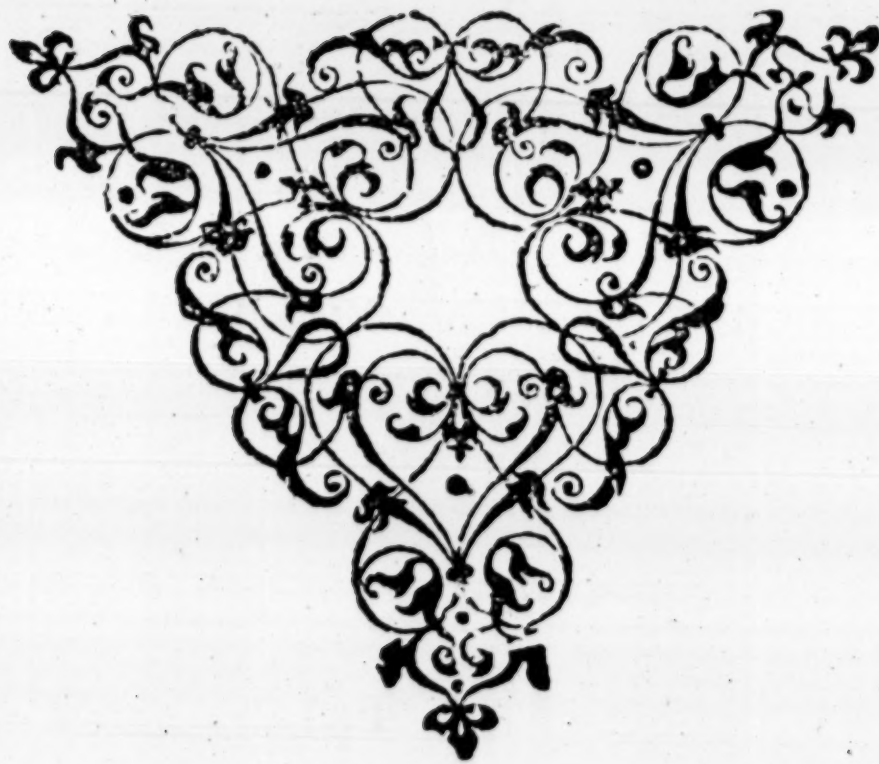
LONDON,  
Printed by Adam Iſlip.  
1602.



278 *A breefe Extract of Maginus, &c.*

found by the proportionall minutes, and the excesse, which were defined before in the 29 definition of the fifth Chapter, and therefore I need not here again to define the same, but onely to tell you, that the proportionall minutes are to be found in the 18 Cannon, in the Column, whose title is *Scrupula Proportionalia*: and the excesse is to be found in the said 18 Cannon, in the Colume, whose title is *Excessus*.

*Here endeth my Extract of Maginus his Theoriques: And if this my labour shall content you, then looke shortly for the vse of the Prutenicall Tables.*



THE  
MAKING, DESCRIP-  
TION, AND VSE, OF  
TWO MOST INGENIOVS AND  
necessarie Instruments for Sea-men, to find out  
thereby the latitude of any place vpon the Sea or  
Land, in the darkest night that is, without the  
helpe of Sunne, Moone, or Starre.

First inuented by my good friend, Ma-  
ster Doctor *Gilbert*, a most excellent Philosopher,  
and one of the ordinarie Physicians to her Majestie:  
and now here plainly set downe in our mother  
tongue by Master *Blundeuile*.



LONDON,  
Printed by Adam Islip.  
1602.







THE MAKING, DE-  
 scription, and vse, of two most Inge-  
 nious and necessarie Instruments for Sea-men,  
 to find out thereby the latitude of any place vpon  
*the Sea or Land, in the darkeſt night that is,*  
*without the helpe of Sunne, Moone, or Starre.*



OF which two Instruments, the one  
 serueth to find out the declina-  
 tion of the Needle vnder any  
 Horizon, which declination  
 being once had, then the other  
 Instrument sheweth the latitude  
 of that place, hauing such de-  
 clination. But because the In-  
 strument of Latitude consisteth of two parts, that is to  
 say, of an immouable part, which I call the Mater,  
 hauing therein a Quadrant, containing the 90 degrees  
 of Latitude, and also a Spirall line: and the other  
 part is moouable, containing a Quadrant, deuided in-  
 to 90 degrees, which are the degrees of declination,  
 and also an Index, with a Fiduciall line, shewing the  
 O o Lati-



**Latitude** : I mind first here to set downe the making of the Instrument of Latitude, because it requireth a number of circles, to find out thereby the Spirall line, contained in the Mater of the said instrument of Latitude, the order whereof is here plainly set downe, as well by this figure demonstratiue, hereto annexed, as by this my description of the same.

*The Figure.*

**F**irst draw a circle vpon a peece of smooth pastbord, so great, as the whole diameter thereof may containe in length at the least seuen or eight inches, and marke the centre of that circle with the letter C: and by drawing two crosse diameters, marked with the letters I F and K E, passing through the said centre, and crossing one another in the same with right angles, you shall thereby deuide the whole circle into foure Quadrants or quarters. And remember, that of the two crosse diameters, the perpendicular, marked with I F, must be produced in such sufficient length, as may serue to such purpose as is hereafter shewed, as from I to H, so as this perpendicular line is marked with foure letters, that is, F C I H, and the other crosse or ouerthwart diameter is marked with three letters, *viz.* K C E. That done, deuide the nether quarter of the said circle on the right hand, marked with the letters F E, into 90 degrees, proceeding from five to five, till you come to 90, marking the same Quadrant with the letters F C E, beginning to account from F to E, which is the arch of the said Quadrant, which I will call from henceforth the inner Quadrant, by helpe whereof you haue to deuide as well the middle Quadrant, marked with L N, as the outwardmost Quadrant, marked with M H, as the Figure sheweth. And the two last Quadrants doe containe each of them 19 circular lines of diuision, making 18 spaces, euery space containing five degrees, and are to be drawn in such order as followeth.

First, you haue to draw a right line paralell to C E, beginning at F, and so proceeding forward towards your right hand in some sufficient length, for the longer, the better to serue your purpose. Then take with your Com-



pas the distance betwixt C and F, and applie that distance to the said right paralell line, by putting the one foot of your Compas in F, and the other at the end of that distance, marking that point with the letter L: then by setting the firme foot of your Compas in C, and by extending the other foot to L, draw a portion of a circle somewhat more than a Quadrant, towards your left hand, and marke the end of that arch with the letter N, which arch is to be deuided into 90 equall parts or degrees, by helpe of 19 circular lines of diuision, to bee drawne as followeth.

First set the firme foot of your Compas in F, and with the other foot, extended to the centre C, draw a circle from C to L, and that shall be the first circle of diuision, shewing that the point L is the first point from whence you haue to account the 90 degrees of the middle Quadrant, proceeding vpward by five and five, vntill you come to 90.

Then to draw the rest of the circles of diuision, belonging to the said middle Quadrant, you haue no more to doe but to remoue the firme foot of your Compas to euery fift degree of the first and inner Quadrant, and alwayes to extend the other foot to the centre C, so shall you justly deuide the arch of the middle Quadrant into 90 degrees. Now to draw the arch of the outwardmost Quadrant, marked with M H, you must doe thus. First take with your Compas the distance betwixt the letter L and the centre C, and applie that distance to the quarter of the first whole circle on the left hand, marked with the letters F K, which you shall find to be all one, then by setting the one foot of your Compas in F, and by extending the other foot to the end of that distance vpon the  
right



right paralell line before drawn, and marked with the letters F L, marke that point or end of distance with the letter M, as you see in the foresaid Figure. Then set the firme foot of your Compas in the centre C, and by extending the other foot to the point M, draw a portion of a circle somewhat more than a Quadrant, towards your left hand, and marke the end thereof with the letter H, which shall be the arch of the outwardmost Quadrant, and must be deuided into 90 equall parts or degrees, by helpe of 19 circles of diuision to be drawne as followeth.

First, by setting the firme foot of your Compas in F, and the other in K, draw a circle from K to M, from which point you must begin to account the 90 degrees of that arch, and so to proceed towards your left hand from 5 to 5 vntill you come to 90, which diuision is to be made by remoouing the firme foot of your Compas to euery fift point of diuision, contained in the arch of the first inner Quadrant, marked with the letters F E, extending alwayes the other mouable foot to the letter K, and so to draw al the circles of diuision belonging to the outwardmost Quadrant. That done, you haue to draw the Spirall line, which cannot bee rightly done, vntill you haue deuided euery one of the circles of diuision, belonging to the outwardmost Quadrant, each one into 90 parts or degrees, beginning your account at euery fift degree of the arch of the same outwardmost Quadrant, and so to proceed from 5 to 5, vntill you come to the letter K, whereas the 90 degree of euery such circle endeth.

*How to draw the Spirall line.*

You see that in the foresaid Figure the Spirall line be-  
 O o iij ginneth



ginneeth at the point L, and endeth at the centre of the first whole circle, marked with C, as the first circle of diuision, belonging to the middle Quadrant, drawne from C to L, doth plainly shew.

But because the said Spirall line is to be drawne so as it may containe 18 seuerall portions, you haue to draw the first portion thereof thus. First deuide the second circular line of diuision, belonging to the outwardmost Quadrant, into 90 equall parts or degrees, proceeding from the first point of the said second line of diuision vnto K, whereas is set downe the 90 degree, seruing to all the 19 circles of diuision belonging to the said outwardmost Quadrant: which is to be done, by deuiding the said second line first into three equall parts, and euery one of those parts again into three. Then last of all euery one of them into two parts, euery part whereof shall containe five degrees. And after this manner is to bee deuided euery one of the 19 lines of diuision belonging to the said outwardmost Quadrant. That done, take with your Compas the first fift part of that second circle, being so deuided, and there make a pricke: at which prick, lay the one end of your Ruler, and lay the other end thereof at the first fift degree of the inner Quadrant, and so draw a dead right line, which will cut the second line of diuision belonging to the middle Quadrant, and there make a pricke, from which pricke to the letter L you haue to draw the first portion of the Spirall line. Now to draw the second portion of the said Spirall line, you must resort to the third circular line of diuision, belonging to the outwardmost Quadrant: and hauing deuided that line into 90 equall parts or degrees, as you did before the second line, and taken thereof with your Compas tenne degrees,



degrees, there make a pricke, to which pricke lay the one end of your Ruler, and the other end to the tenth degree of the inner Quadrant, and draw a dead right line, which wil cut the third circular line, seruing to the middle Quadrant, and there make the second pricke, from which pricke you haue to draw the second portion of the Spirall line, so as it may joine with the first portion. Then to draw the third portion of the Spirall line, you must proceed to the fourth circular line of diuision, belonging to the outwardmost Quadrant, and deuide that into 90 degrees, as you did before, whereof you must take 15 degrees, and there make a pricke, to which pricke you must lay the one end of your Ruler, and the other end to the 15 degree of the inner Quadrant, and hauing drawne a right dead line, you shall find that it will cut the fourth circular line belonging to the middle Quadrant, and there make a prick, from which pricke you haue to draw the third portion of the Spirall line, so as it may joine to the end of the second portion thereof. Now to find out the rest of the 18 portions of the Spirall line, you must obserue the selfesame order of working, which you did before in finding out the first three portions.

Thus hauing plainly described vnto you the making of the immouable part or Mater of the said Instrument, I will now shew you how to make the moouable part: which, as I said before, is none other thing but a Quadrant, hauing an Index, with a Fiduciall line, answerable in all respects to the first inner Quadrant, differing onely in letters. For wheras the inner Quadrant is marked with the letters F C E, this for difference sake, and for the right placing the same vpon the Mater, is marked with  
the

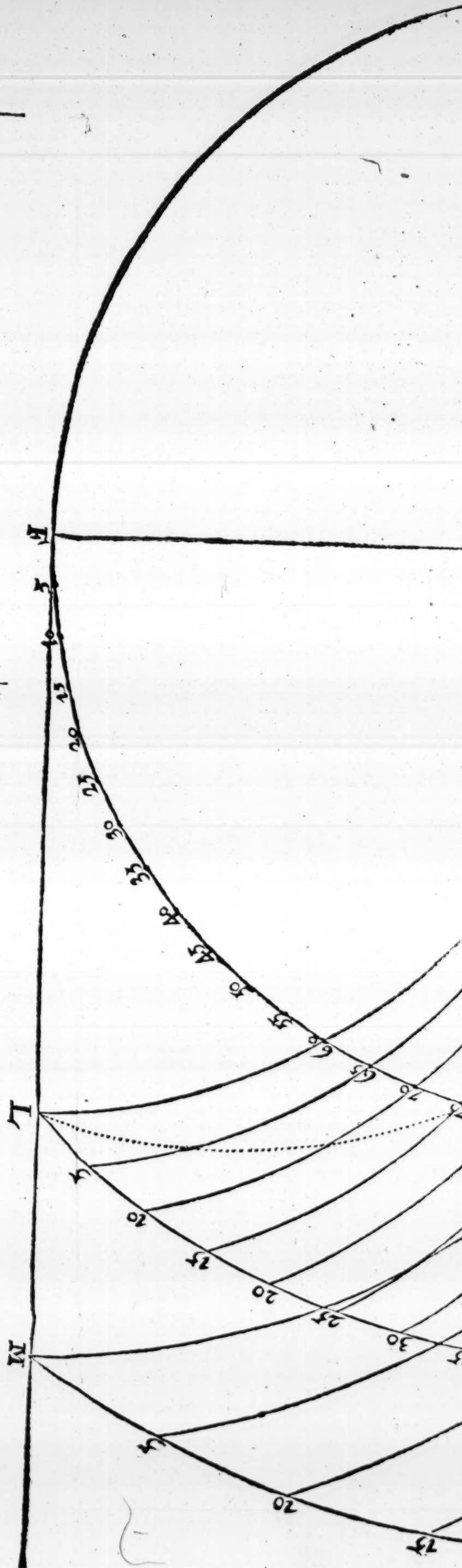
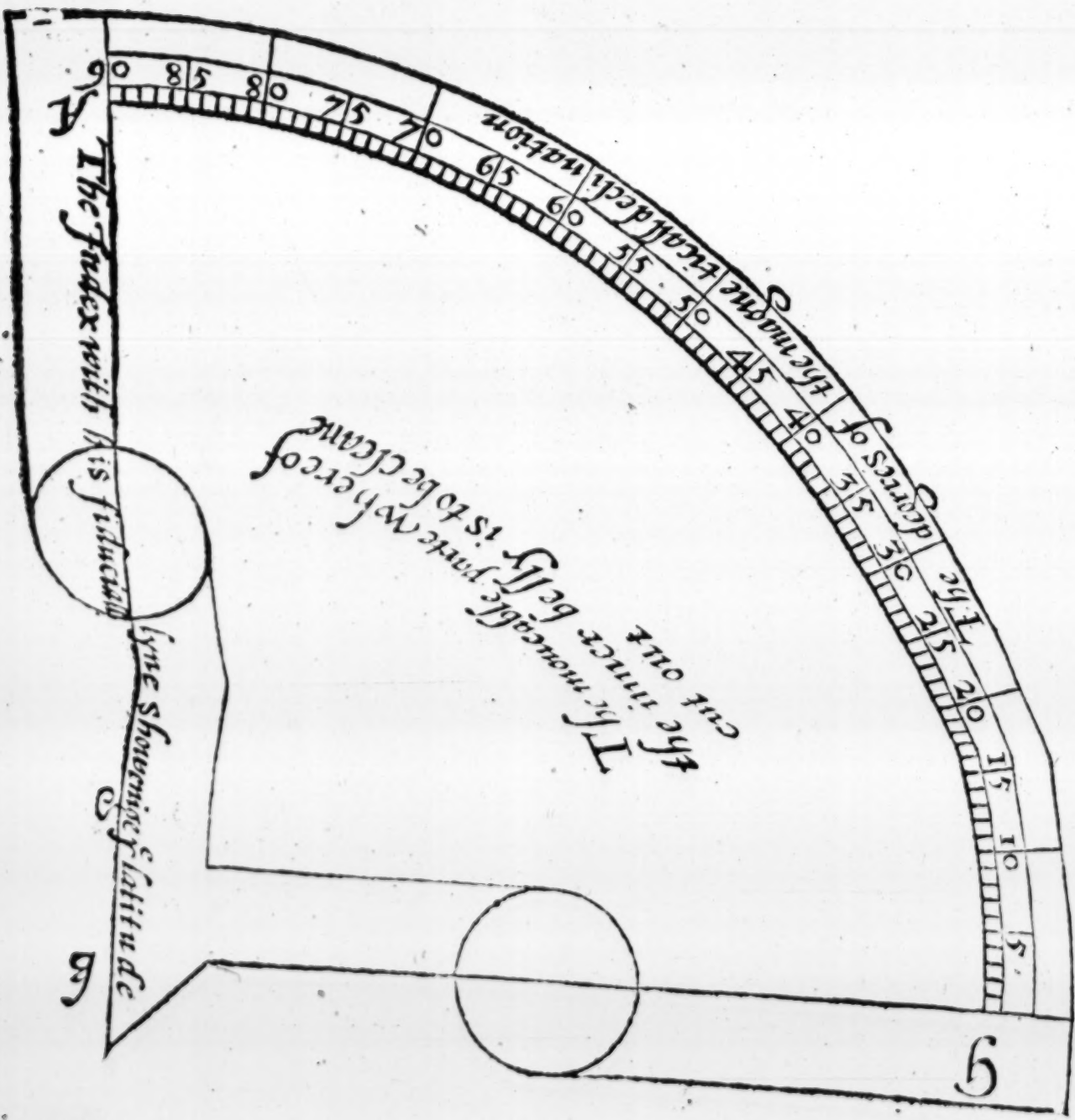
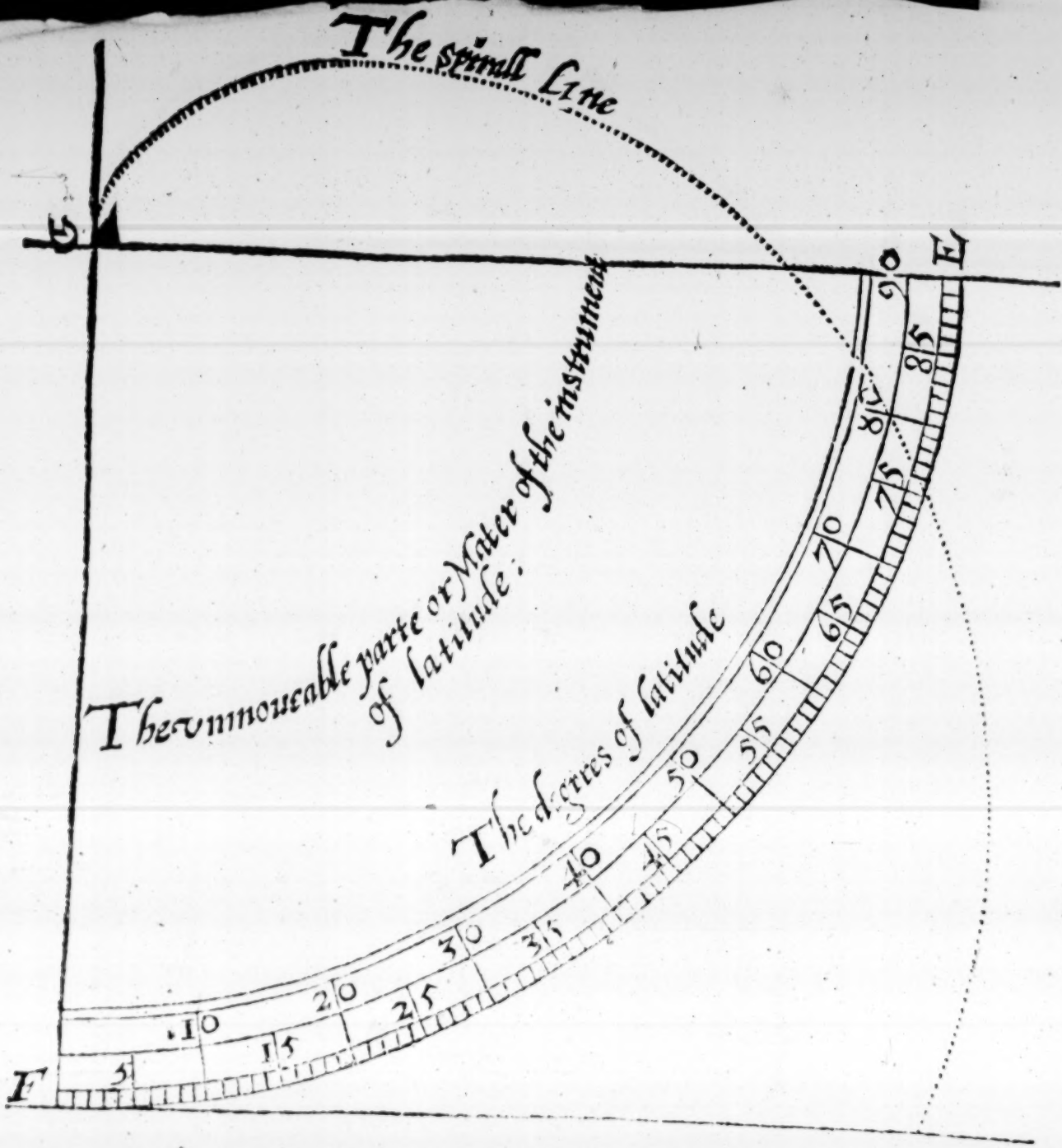


the letters A B G. For when you come to vse this Instrument, you must place the angle A of the moouable Quadrant vpon the centre C of the inner Quadrant, there to be fastened with a pin, so as the moouable Quadrant may turne round about vpon the Maier.

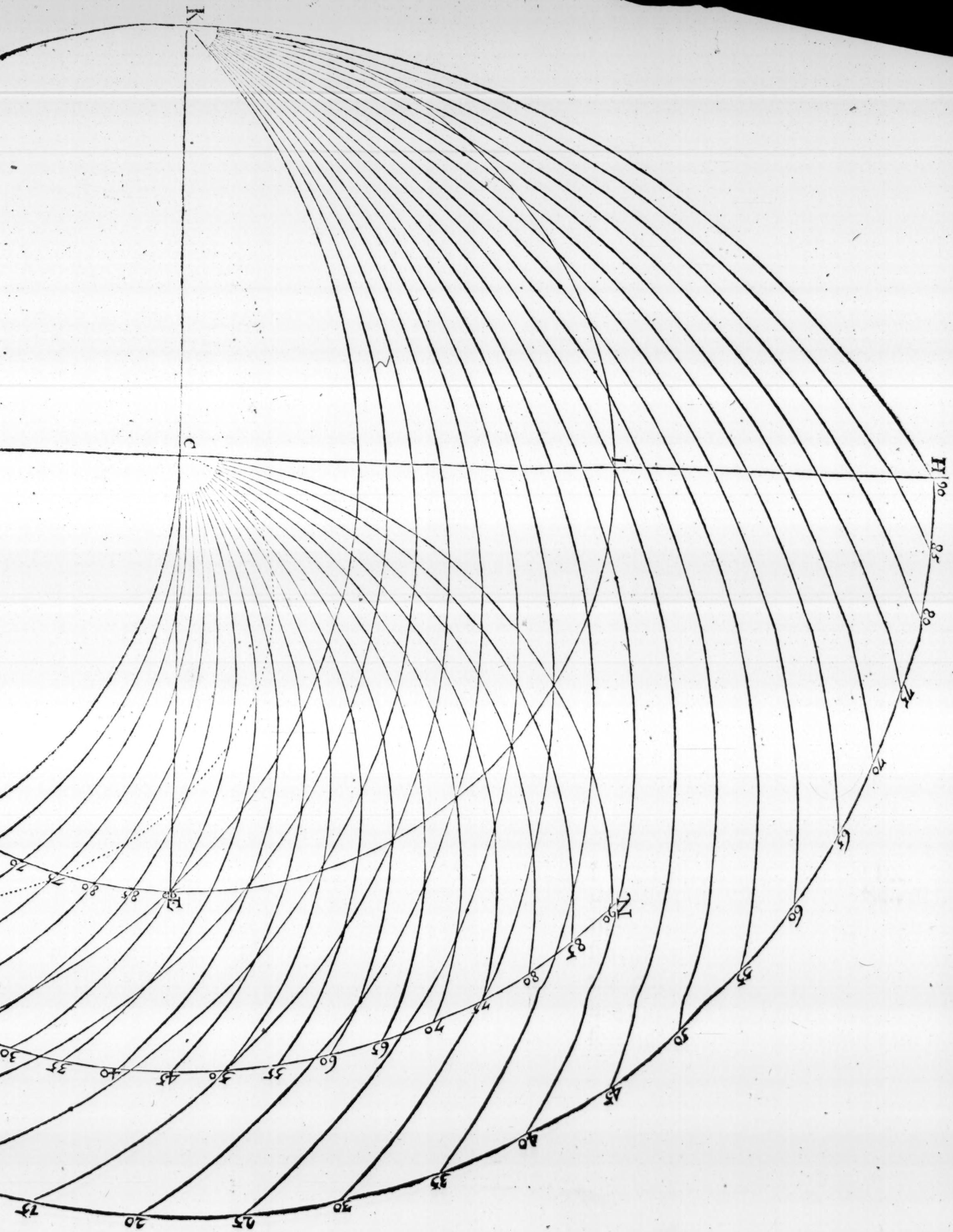
And because this Instrument is not auailable, without the helpe of the other Instrument of Declination, I haue therefore here set downe the shape of that Instrument of Declination, together with a plaine description thereof, and then I will shew the vse of both the said Instruments.

This image shows a blank, aged, cream-colored page, likely an endpaper or flyleaf from an old book. The paper has a slightly textured appearance with some minor discoloration and small dark spots, possibly due to age or handling. The right edge of the page is slightly irregular, suggesting it was part of a bound volume. There is no text or other markings on the page.



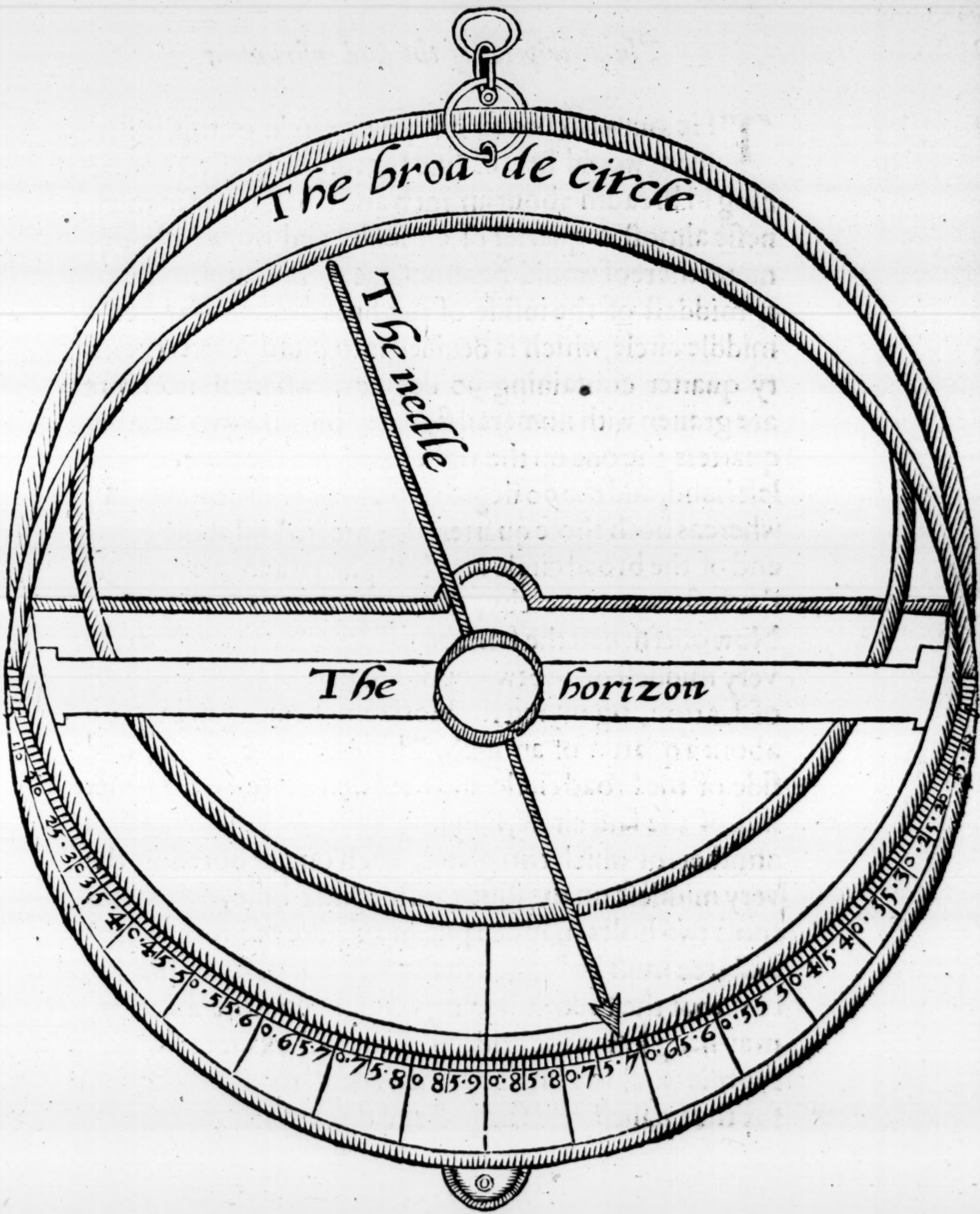














*The description of the said Instrument.*

**T**He outward broad hoope or circle of this Instrument would bee of fine Latton or Brasse, containing in breadth about an inch and a halfe, and in thicke- nesse almost a quarter of an inch, and the whole diameter thereof would be about five inches, and in the very middest of the inside of the broad circle is traced a middle circle, which is deuided into foure quarters, eue- ry quarter containing 90 degrees, whereof no more are grauen with numerall figures, but the two neather quarters, the one on the right hand, and the other on the left hand, and the 90 degree is placed at the neather end, whereas both those quarters doe meet. And at the vpper end of the broad circle is to bee placed a ringle to hold the Instrument thereby, when you would vse the same. Now ouerthwart the said broad circle are fastened in the very middest of the two outsides thereof, two thin plates of Latton, signifying the Horizon, bearing in breadth about a quarter of an inch. The one plate on the one side of the broad circle, and the other plate on the other side of the said circle, standing right and just one against another: of which two plates, each one is bored in the very middest on the inside with a little hole, so as into those two holes may bee put an axletree of yron, which axletree must be biggest in the very middest, to the intent that the Needle beeing wrought into the axletree, may hang just in the middest of the said axletree; which Needle would be smaller at the one end than at the other, for the smallest and sharpest end thereof being touched  
with

with a perfect stone, dooth alwaies shew the Magneticall declination of the place, whereas you make your triall. And the Needle it selfe would be in length almost equall to the whole diameter of the broad circle, yet so, as it may easily play and turne vp and downe, without touching the same. These parts being fitly and artificially set together, you haue to couer the two outsides of the Instrument, each of them with a round and cleare glasse, that through them you may alwayes see vpon what degree the sharpe point of the Needle falleth, after it remaineth steadie without mouing: which glasses, seruing to keepe the Needle from wind and dust, would be so fastened to the outwardmost edge of the broad circle, as they may stand sure, and not fall away.

*The vse of the said two Instruments.*

**F**irst to find out by this Instrument the declination of the Needle vnder the Horizon vpon the land, you must resort into a place void of wind: or if you would trie it vpon the Sea, I thinke it best to goe to that place or coubbard of the ship, wherein the Mariners Compas is wont to stand, and there steadily to hold the Instrument, hanging vpon your right or left thombe, so as it may hang right North and South, according as the Mariners Compas dooth direct you, or els by helpe of some little Diall, whose Needle is touched with a perfect stone, and when you see that the Needle standeth still, marke well vpon what degree in the middle line of the broad circle it falleth, for that shall bee the degree  
P p ij of



of Declination for that place. And hauing found the degree of Declination, take into your hand the Instrument of Latitude, made of Brasse or Pastbord, in such forme as you see set downe on the right hand of the first figure demonstratiue: which Instrument of Latitude consisteth (as I haue said before) of two parts, the one vnmouuable, called the Mater, and the other mouuable. In the Mater is described a Quadrant, deuided into 90 degrees, which are the degrees of Latitude, and also the Spirall line. And the mouuable part containeth a iust Quadrant, deuided also into 90 degrees, which are the degrees of Declination, together with his Index, hauing a Fiduciall line to shew the latitude: and this mouuable part, when you come to vse it, must bee placed vpon the Mater, so as the angle A of the mouuable part must bee fastened with a pin vpon the centre or angle of the Mater, marked with the letter C, in such sort as the mouuable Quadrant may turne round about vpon the Mater. That done, seeke out in the arch of the mouuable Quadrant, the degree of Declination, before found by the instrument of Declination; and lay that degree iust vpon the Spirall line, described in the Mater, and holding it fast there with your thombe, looke at that very instant vpon what degree of latitude the Index with his Fiduciall line falleth, for that shall be the latitude of that place.

As for example, M. Doctor *Gilbert* hauing found by the Instrument of Declination, as he wrote to me, the declination at London to be 72 degrees: then by applying the same to the Instrument of Latitude, in  
such

such order as is before taught, he found the latitude of London to be 51 degrees, 32 minutes. And I prouing the same at mine owne house at Newton Flotman, not distant aboue foure miles Southward from Norwich, I found the declination of the Needle to bee 73 degrees and a little more, and thereby I found our latitude here to be 52 degrees or thereabout.

Both these Instruments I receiued not long since from my deare friend M. Doctor *Gilbert*, for the which I most heartely thanke him, the inuention of which Instruments deserueth more worthie commendation and praise, than I am able any way to yeeld, hoping that all Sea-men will bee as thankfull to him as I am in heart and good will, for whose profit there was neuer inuented from the beginning of the world two such noble and necessarie Instruments as these are, and therefore worthie to be esteemed of all men accordingly.

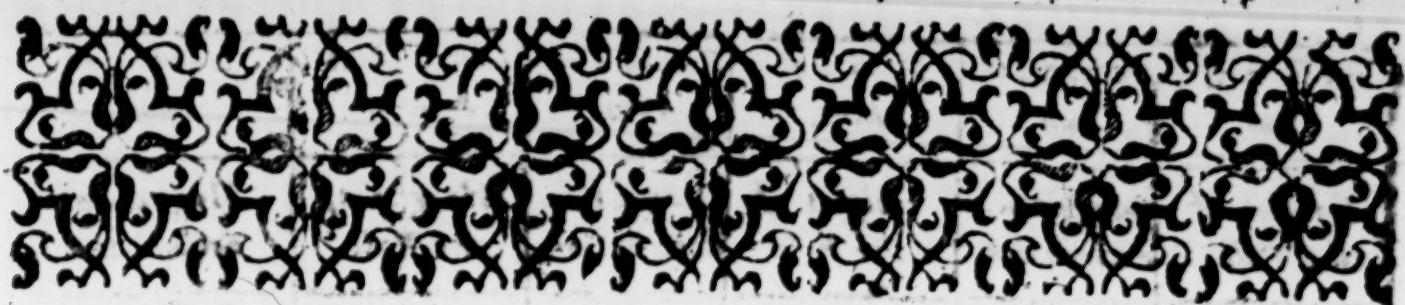
By helpe of the said Instrument of Declination, you may also readily find out the variation of any Mariners Compas in North Easting or North-Westing, if you place the Instrument within such a standerd as *Robert Norman* dooth set downe by figure in his booke called, *The new Attractive*: which point, Master *Borrough* would haue to be called the Respective point, and not the Attractive. But M. Doctor *Gilbert* in his booke *De Magnete*, prooueth by diuers good demonstrations that it ought most properly to be called the point of Coition, or the point Coitiue, and neither Respective



nor Attractive. The manner how to vse the said Instru-  
ment, in seeking to know the variation of the Marriners  
Compas in any latitude, is the selfe-same which *Robert*  
*Norman* and Master *Borrough* doe set downe in  
the foresaid booke, whereunto I doe  
referre you, and so bid you well  
to fare.

**FINIS.**





A short Appendix annexed to the former Treatise by *Edward Wright*, at the motion of the right Worshipfull M. Doctor *Gilbert*.



Because the making and vsing of the foresaid Instrument, for finding the latitude by the declination of the Magneticall Needle, will bee too troublesome for the most part of Sea-men, being notwithstanding a thing most worthie to be put in daily practise, especially by such as undertake long voyages: it was thought meet by my worshipfull friend M. Doctor *Gilbert*, that (according to M. *Blundeilles* earnest request) this Table following should be bereunto adioined; which M. *Henry Briggs* (professor of Geometrie in *Gresham Colledge* at London) calculated and made out of the doctrine and tables of Triangles, according to the Geometricall grounds and reason of this Instrument, appearing in the 7 and 8 Chapter of M. Doctor *Gilberts* first booke of the Loadstone. By helpe of which Table, the Magneticall declination being giuen, the height of the Pole may most easily be found, after this manner.

With the Instrument of Declination before described, find out what the Magneticall declination is at the place where you are: Then looke that Magneticall declination in the second Colonne of this Table, and in the same line immediatly towards the left hand, you shall find the height of the Pole at the same place, vnlesse there be some variation of the declination, which must be found out by particular obseruation in euery place.

The Table followes on the next Page.



First Col- umn.	Second Col- umn.		First Col- umn.	Second Col- umn.		First Col- umn.	Second Col- umn.	
Heights of the Pole.	Magnetical declination.		Heights of the Pole.	Magnetical declination.		Heights of the Pole.	Magneticall declination.	
Degrees.	Deg.	Mon.	Degrees.	Deg	Min.	Degrees.	Degr.	Min.
1	2	11	31	52	27	61	79	29
2	4	20	32	53	41	62	80	4
3	6	27	33	54	53	63	80	38
4	8	31	34	56	4	64	81	11
5	10	34	35	57	13	65	81	43
6	12	34	36	58	21	66	82	13
7	14	32	37	59	28	67	82	43
8	16	28	38	60	33	68	83	12
9	18	22	39	61	37	69	83	40
10	20	14	40	62	39	70	84	7
11	22	4	41	63	40	71	84	32
12	23	52	42	64	39	72	84	57
13	25	38	43	65	38	73	85	21
14	27	22	44	66	35	74	85	44
15	29	4	45	67	30	75	86	7
16	30	45	46	68	24	76	86	28
17	32	24	47	69	17	77	86	48
18	34	0	48	70	9	78	87	8
19	35	36	49	70	59	79	87	26
20	37	9	50	71	48	80	87	44
21	38	41	51	72	36	81	88	1
22	40	11	52	73	23	82	88	17
23	41	39	53	74	8	83	88	33
24	43	6	54	74	52	84	88	47
25	44	30	55	75	35	85	89	1
26	45	54	56	76	27	86	89	14
27	47	15	57	76	57	87	89	27
28	48	34	58	77	37	88	89	39
29	49	54	59	78	15	89	89	50
30	51	11	60	78	53	90	90	0

